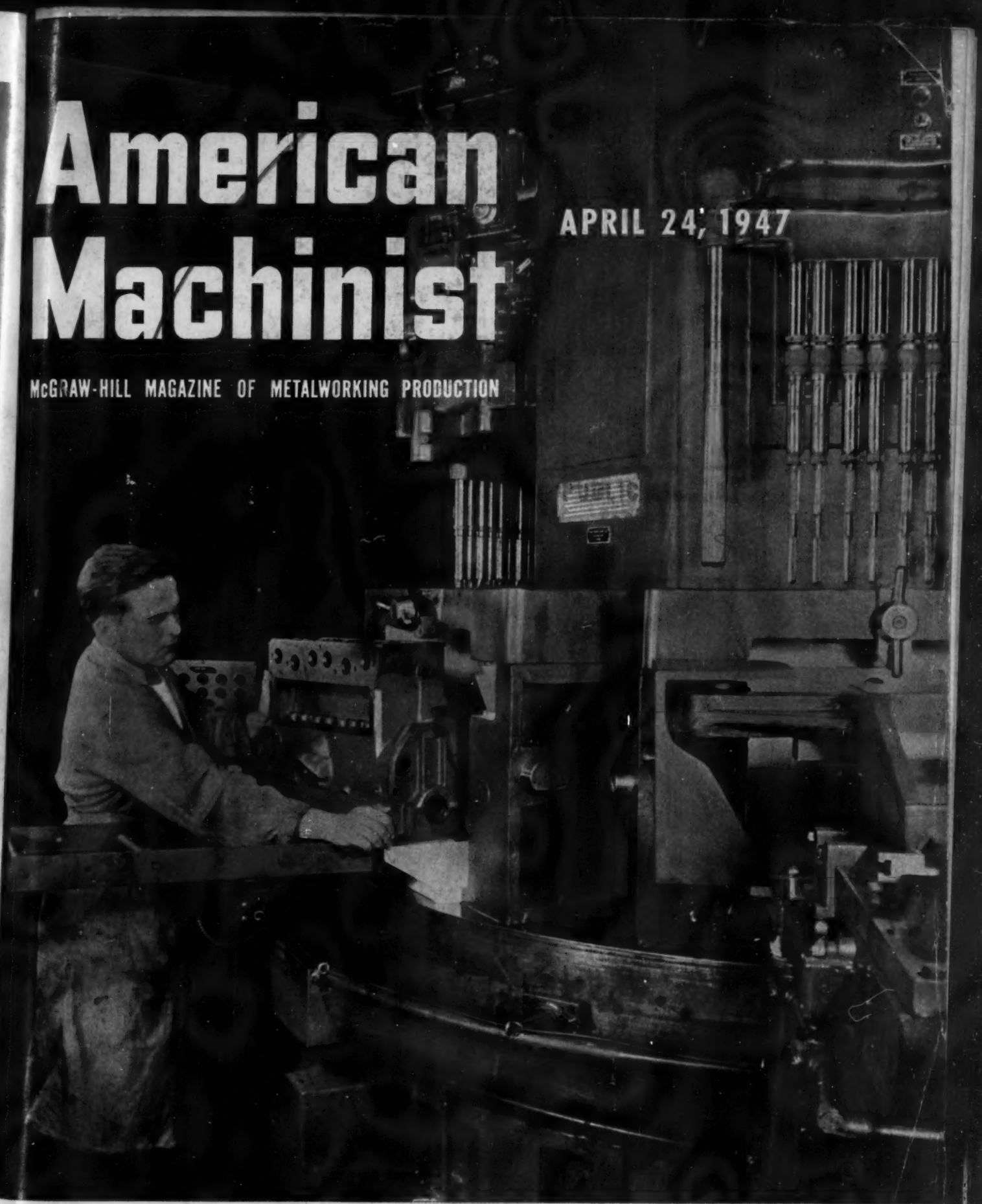
American Machinist

APRIL 24, 1947

McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

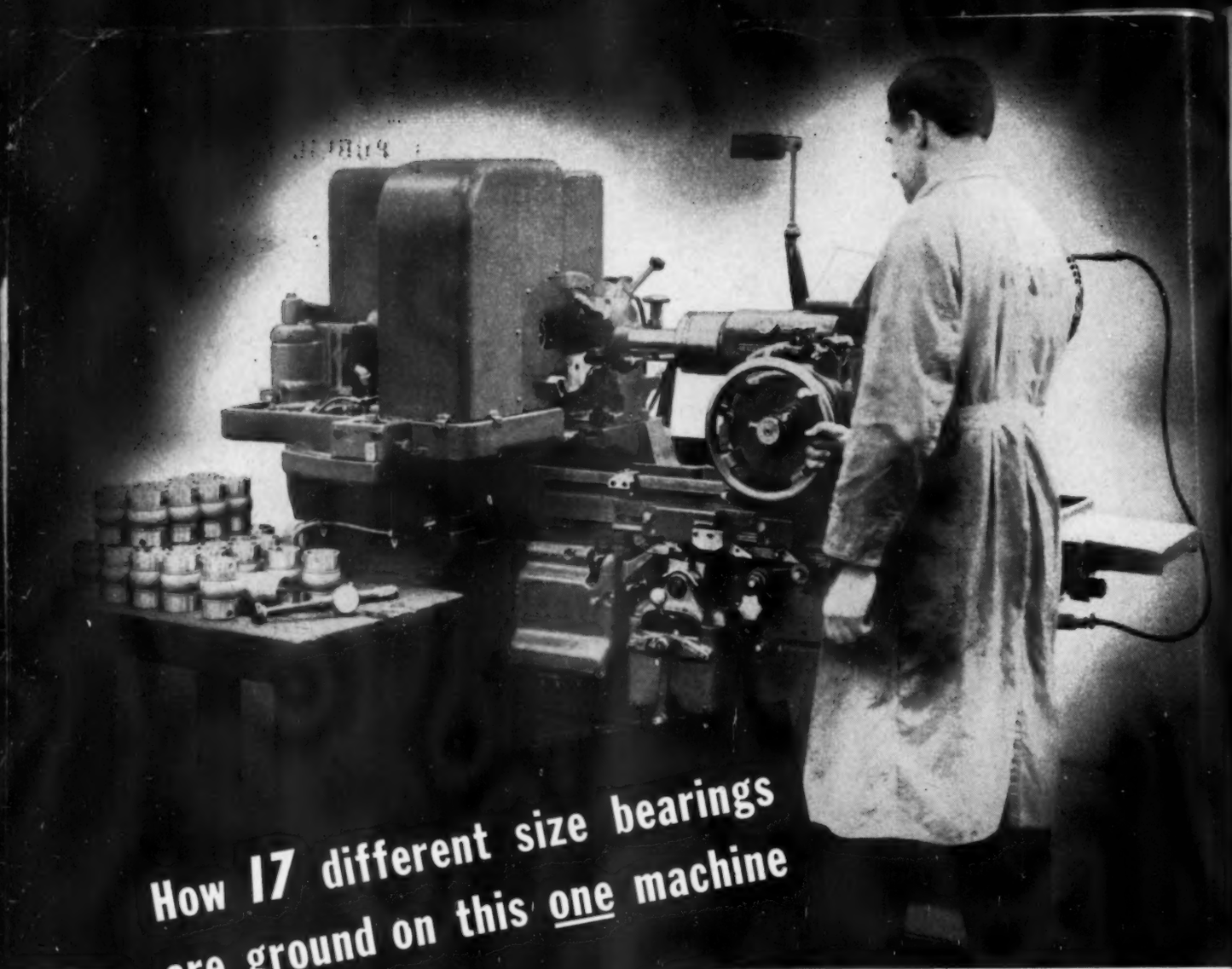


In this issue

HOW TO SET UP CARBIDE MILLING JOBS

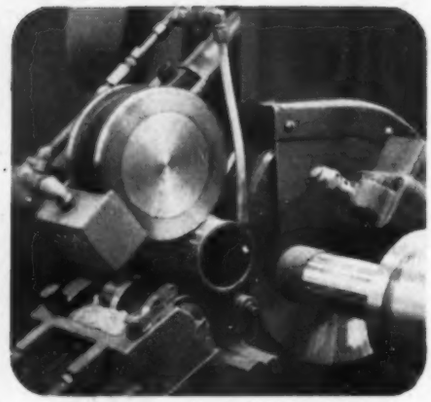
PLASTICS SIMPLIFY AUTO-BODY TOOLING

INCENTIVES WORK IN THE TOOLROOM TOO



How 17 different size bearings are ground on this one machine

It's the Heald No. 72-A Centerless Internal —a really versatile grinding machine



This closeup of a Centerless workhead shows how a bearing part is located and rotated between three rolls. Large roll drives it, bottom roll supports it, and a pressure roll on top holds it in place. Bore is actually generated from its own outside diameter, assuring perfect concentricity.

IMAGINE THE CAPACITY of a machine that can finish-grind 17 *different sizes* of inner bearing races—automatically, and with consistent accuracy that insures absolute concentricity between ground bore and O.D.! That's what this manufacturer of self-aligning bearings is getting with his Heald No. 72-A Centerless—as well as meeting production and cost requirements which could not be satisfied by previous methods.

These results, moreover, are obtained with very little operator attention. The machine runs automatically from the time the operator loads the work and starts the cycle until the work is finish-ground to absolute size. And convenient hand-loading plus readily adjustable Centerless rolls permit quick and easy changes in setups for the various sizes.

You can get the Heald No. 72-A Centerless either as a plain machine or with any combination of automatic size controls—to meet your toughest internal grinding requirements. For further information, get in touch with the Heald branch office nearest you, or write: THE HEALD MACHINE COMPANY, Worcester 6, Mass.

HEALD

means more precision . . . less cost

Branch Offices at Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • New York

INTERNAL AND SURFACE GRINDING MACHINES · BORE-MATIC PRECISION FINISHING MACHINES

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American Machinist

MAGAZINE OF METALWORKING PRODUCTION

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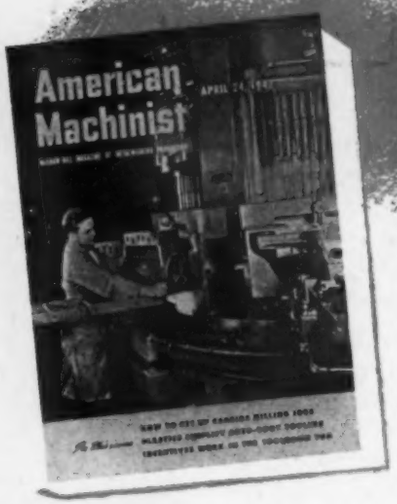


Chips and QUIPS

Center-column Drill . . . Our cover Kodachrome pictures a center-column, 6-station, 40-spindle, hydraulic-feed, valve-hole drilling machine which finishes the eight valve-guide and tappet holes of fifty 4-cyl. automotive cylinder blocks an hour. At the last four stations, hydraulically operated guide-bushing plates enter the valve chamber to guide tools operating in tappet holes. Plates are registered to the fixture by two bars extending from the head.

On this Foote-Burt unit, operations are: Station I: Load block. Station II: Rough-bore valve throats and spot-drill guide holes. Station III: Drill valve-guide holes. Station IV: Drill valve-tappet holes. Station V: Semifinish-ream valve-guide holes, rough-ream tappet holes and valve throats with multiple-diameter tools. Station VI: Size-ream valve-guide holes, and semifinish-ream tappet holes and valve throats.

Toolroom Incentives . . . Some incentive plans have failed because they covered only production departments, brought only criticism from supervision and service departments. S. S. White Dental Mfg. Co. has a system that works in the toolroom, too . . . in this issue.

Modern Milling . . . Milling with carbides is today a major production process. It is, therefore, with considerable pride that we present in this issue a 24-page special report on analyzing and setting up carbide milling jobs, a compendium of the researches during the last several years and in a number of plants. Prepared by H. A. Frommelt, it was ten articles—but we've put it in one package.

Plastic Car . . . Briggs has been doing some tricky work with laminated plastics in interior styling of auto bodies, now predicts entire interiors, including upholstery, may be of plastic materials. Chester S. Ricker, our Detroit sleuth, dug out the facts of fabrication, shows them in the photo-and-sketch combination that gives you so much with so little expenditure of your time. The technique is tough on editors — but halves the space and decimates the reading time, so we think it's worth it.

Cover Technology . . . Notice anything peculiar about our Feb. 13 cover? Several readers in one Boston plant did—and their spokesman phoned us about it. The operator is standing so he can't read his big mike without removing it, and the lathe has been stopped in mid-cut, so the tool will dig in when it's restarted. Bet we can tell you what happened: The photog said: "Can you stand on the other side of this thing (compound rest) and hold that thing (mike) like this. And let's have a chip hanging from the tool—makes a better picture." That's what they call artistic license—and on occasion even our objecting voice is swamped. Who are we to criticize an "artiste"?

Who Buys Equipment? . . . In many plants, foremen play a major part in selecting equipment their men are to use; in others, the foreman's knowledge and ability are not utilized as they should be. In this issue, the story's told—in a one-pager that's brisk.

Coming . . . May 8 *A.M.*, just for contrast with this issue, will include many short articles on a wide variety of subjects—one of the elements in preserving the editorial balance that gives you a well-rounded reading diet. There'll be an excellent story on carbon fixtures for soldering that makes savings in several directions, "Forging Practice"—second 16-page part of our special report (first part April 10), data on high-production methods at Buick, on second operations in Brown & Sharpe automatics, a procedure ("shrinkage analysis") for analyzing production rejects by Eugene Goddess of North American Phillips, the first of a 3-article series on specifying machine tools for carbides, details on designing ejector pins for plastic molds, something on optical measurement, on plastic ways for machine tools, on shop safety and some Shop Shots from R. Hoe & Co. . . . There are even a couple of shop smiles.

CARBIDE MILLER . . . Consulting engineer heading up a group specializing in engineered production with carbides, H. A. Frommelt was director of milling research at Kennametal, Inc. (1944-46), and director of research at Kearney and Trecker (1937-44). At K&T he worked on technique and tools for carbide milling, particularly of steel. At Kennametal, he devoted his attention to refinement of cutter design and customer applications of carbide milling. It is his experiences during this 10-year period that forms the basis of our current special report. He was also head of Mech. Engrg., Marquette University (1928-37), apprentice supt. (1920-23) and asst. works manager (1923-28) of the Falk Corporation. He has his B.S.E.E. and E.E. from Iowa State, and an M.A. from St. Louis University.

MAINTAIN QUALITY

QUALITY IN BEVEL GEARS starts with the gear generator itself. Gleason straight bevel gear generators are built to cut gears accurately . . . to the very latest design. For example, Coniflex gears, the straight bevels with localized tooth bearing, are cut on the new Gleason straight bevel generators.

MAINTAIN QUALITY by constant control of gear production . . . test gears for desired tooth bearing . . . keep tools sharpened for smoothness of surface finish and accuracy . . . all are fundamental to making better bevel gears. That is why the Gleason No. 13 Universal Tester and the No. 12 Generator Tool Sharpener are an integral part of every straight bevel gear cutting department.

The No. 12 Generator Tool Sharpener sharpens the tools to a smoothness of surface finish and accuracy demanded by modern bevel gear applications and assures long life of the cutting tools employed.

A running test on the No. 13 Universal Tester

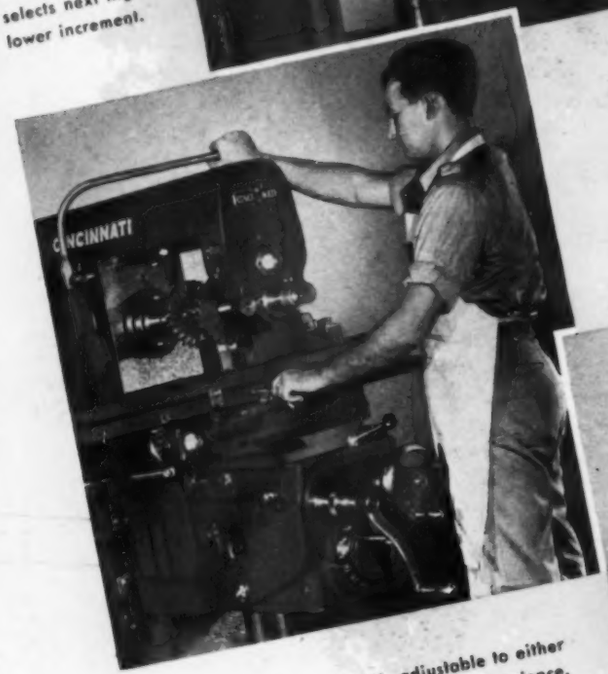
1. Establishes correct setup for gear generator *before production.*
2. Assures maintenance of uniform quality of gears during production.
3. Finds best position for gears in final assembly.

GLEASON *Works*
1000 University Avenue
Rochester 3, N.Y., U.S.A.

Builders of Bevel Gear Machinery for Over Eighty Years

WHY YOU SHOULD SELECT A MACHINE THAT'S *EASIER*

CHANGING FEEDS. It's easy on the 2 ML —half-turn of a crank selects next higher or lower increment.



STARTING LEVER on 2 ML, adjustable to either side of machine for maximum convenience.

CHANGING SPINDLE SPEEDS. Simply rotate a single crank type control while hydraulics do the work of shifting gears. Drawings at the right tell how.

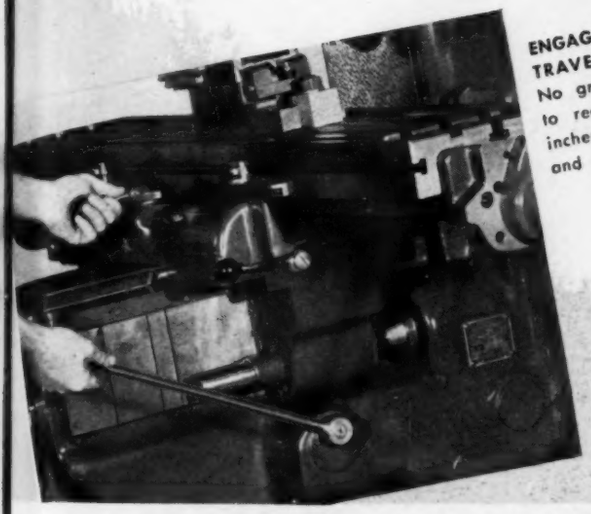
CINCINNATI

THE CINCINNATI MILLING

MILLING MACHINES

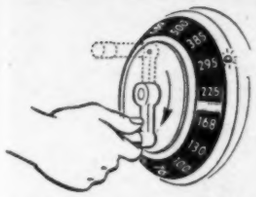
● It's evident why shopmen like a machine that's easy to set up and operate. Perhaps not so evident, but nevertheless it's true, "ease of operation" reflects through an entire organization, from the man at the machine to the yearly financial statement. There are fewer rejects; percentage of labor turnover shrinks; accidents decrease. That's why special attention has been paid to convenience and ease of operation and setup for the new CINCINNATI No. 2 ML Milling Machine. The illustrations on these two pages show how this has been accomplished. ¶ The 2 ML, companion machine to the CINCINNATI No. 2 MI, has many other advantages. It's safe to operate; stays accurate for years; maintenance cost is low. Powered by a 3 h.p. motor and built in Plain and Universal styles, the versatile No. 2 ML is ideal for a wide variety of milling operations in shops of all kinds; for vocational schools; for seagoing machine shops. Catalog M-1507-1 contains complete engineering data.

TO OPERATE!

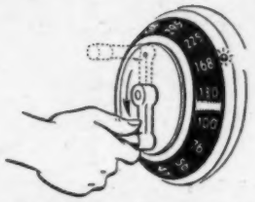


ENGAGING POWER RAPID TRAVERSE to the table. No groping or stretching to reach the lever. 150 inches per minute table and cross; 75 vertical.

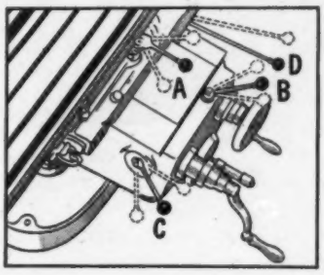
RESETTING MICROMETER DIALS the 2 ML way. Just pull out dial against light spring pressure, rotate it to setting desired.



A single lever selects all speeds. In the example shown one *half turn to the right* changed spindle speeds from 225 to the next higher speed, 295 r.p.m.



In this example one *half turn to the left* of the single speed dial lever changed spindle speed from 225 to the next lower speed, 168 r.p.m.



Convenient location of independent and directional power feed controls: A—Table feed lever. B—Cross feed lever. C—Vertical feed lever. D—Rapid traverse lever.

MACHINE CO. CINCINNATI 9, OHIO, U. S. A.

BROACHING MACHINES • CUTTER SHARPENING MACHINES

Microscopic ACCURACY . . .

Rack and pinion
4 times actual size.

Cutting helical pinion on Fellows
3-inch Fine-Pitch Gear Shaper.

PHOTOS COURTESY BAUSCH & LOMB OPTICAL COMPANY

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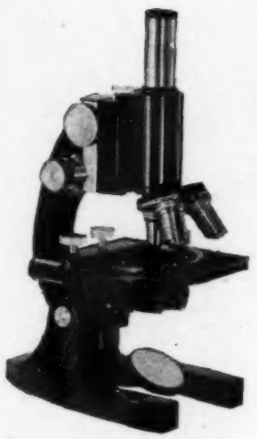
THE FELLOWS METHOD . . . MACHINES AND TOOLS FOR

IN MORE WAYS THAN ONE!



Finest Optics, Reinforced with the Ultimate in Rack and Pinion Focussing Precision

The focussing adjustment of the Bausch & Lomb series of microscopes depend upon fine-pitch helical racks and pinions whose inherent precision must relate to the high-power magnification of the optical system. The main focussing motion between the microscope stand and body, and of the mechanical stage and sub-stage movements as well, must be smooth-working through their entire traverse... and at the same time secure enough to eliminate "creep" when the instrument remains focussed on an object. Zero backlash is an added specification to eliminate all lost motion in adjusting knobs. At the same time it is necessary not to create "starting friction".

Such operating requirements impose the most severe tolerances in parallelism between the racks and pinions shown. In making such instrument parts on Fellows Gear Shapers, fine feeds and the finest of finish is more important than mass production rates. Yet, within the limits imposed, 28 sets of racks and pinions are produced per hour, one operator running two machines, and checking the work at the same time!

Any manufacturer faced with a problem of high accuracy and fast production of small fine-pitch gears, racks, and pinions will do well to investigate the economies of Fellows equipment. The Fellows Gear Shaper Company, Springfield, Vermont... or 616 Fisher Bldg., Detroit... or 640 West Town Office Bldg., Chicago.

Principal Specifications

Depth of Cut . . . .0358 inch
Pressure Angle . . . . . 20°
Helix Angle . . . . . 14° 30″
Backlash . . . . . NONE

Bearing diameter and pitch diameter of pinion must be concentric within—.0001 inch

Pitch line and mounting surfaces of rack must be parallel within—.0005 inch

Fellows

ALL OPERATIONS FROM BLANK TO FINISHED GEAR

HERE'S A REAL Test

. . . grinding the teeth

•Tailor-made parts manufactured in small quantities of say one to ten, and requiring several close tolerance grinding operations, afford an excellent test of the precision performance of the grinding machine. The internal broach being ground in the illustration on the opposite page easily qualifies as the daddy of all parts of this type, and each tooth is ground separately. ¶A prominent broach manufacturer chose a CINCINNATI FILMATIC Hydraulic Universal Grinding Machine for the job, because he can depend upon sizing. This is an exceptionally important consideration, for there can be no second guessing in grinding these expensive parts. Each tooth must be accurately ground with respect to the next one. ¶CINCINNATI FILMATIC Hydraulic Universal Grinders have many features of value in precision toolroom grinding, such as FILMATIC Grinding Wheel Spindle Bearings; Infinitely Variable Headstock Speeds; hinged Internal Grinding Attachment, and others. Would you like to know more about them? Catalogs listed below will be sent on request.

CINCINNATI FILMATIC 14" Hydraulic Universal Grinding Machine. Catalog G-486-4 covers the 12" machine, and catalog G-474-3 the 14", 16" and 18" machines.

CINCINNATI GRINDERS

CENTER TYPE GRINDING MACHINES

# of Performance

of an internal broach

Grinding an internal broach on a CINCINNATI FILMATIC 14" Hydraulic Universal Grinder. The taper portion is ground by the traverse method, and then each tooth is "backed off" separately, using the hand cross feed. The operator depends largely upon the cross feed dial reading.

INCORPORATED CINCINNATI 9, OHIO, U. S. A.

CENTERLESS GRINDING MACHINES • CENTERLESS LAPPING MACHINES

VAN NORMAN No. 2 HEAVY
Table: 58" x 13"

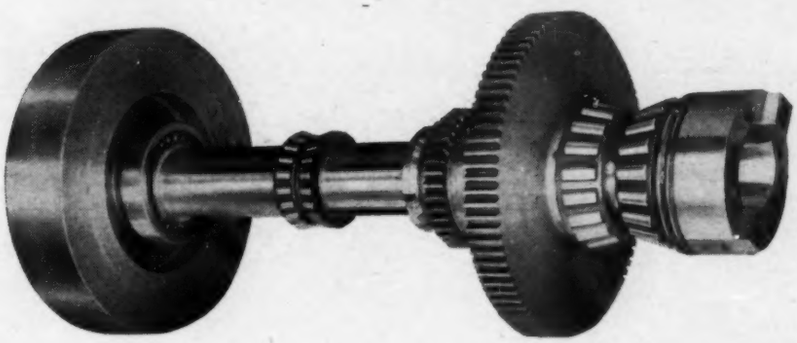
"It Pays to Van Normanize"

VAN NORMAN

No. 2 HEAVY

The Miller that Gives You

Extra Cutability!



BUILT-IN SPINDLE FLYWHEEL, mounted inside the column, plus heavy bull gear, assures uniform uninterrupted transmission of vibrationless power to cutter. The heavy flywheel increases and improves cutability . . . permits smoother finish of work surface.

5 ANTI-FRICTION BEARINGS support the large diameter alloy steel spindle at each end and center. They maintain accuracy by assuring maximum spindle strength and rigidity under every type of cut.

Other Van Norman features that pay off in profits include . . . front and rear hand, power and rapid traverse controls, overarm pilot wheel, single lever speed and feed selectors, anti-friction bearings throughout, alloy steel multi-splined shafts, automatic lubrication, ease of spindle control and large easy-to-read dials.

This new heavy-duty Van Norman Horizontal Milling Machine offers users greater opportunities to increase production and cut costs on a wide variety of milling applications.

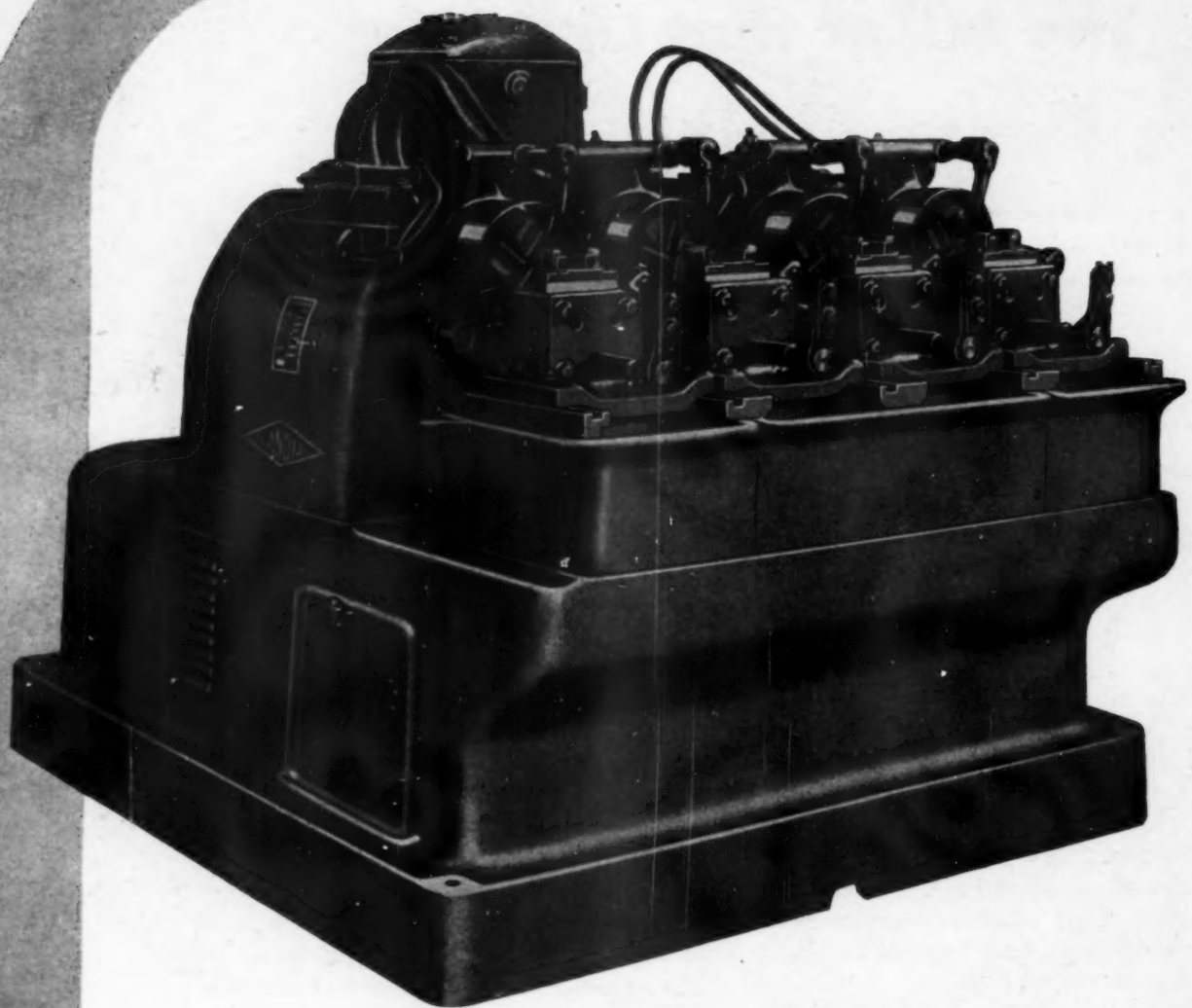
The Van Norman No. 2 Heavy is available with plain or universal saddle. Write for information and catalog.

VAN NORMAN COMPANY

SPRINGFIELD 7, MASSACHUSETTS

LANDIS

SEMI-AUTOMATIC



OUTSTANDING ADVANTAGES ARE:

- Low Labor Cost per piece
- Quick Set-Ups
- High Production at Low Threading Speeds
- Flexibility for all Diameters and for Special Threading Operations
- Elimination of Side Shave at Start of Thread
- Thread Concentricity

LANDIS MACHINE

4 SPINDLE

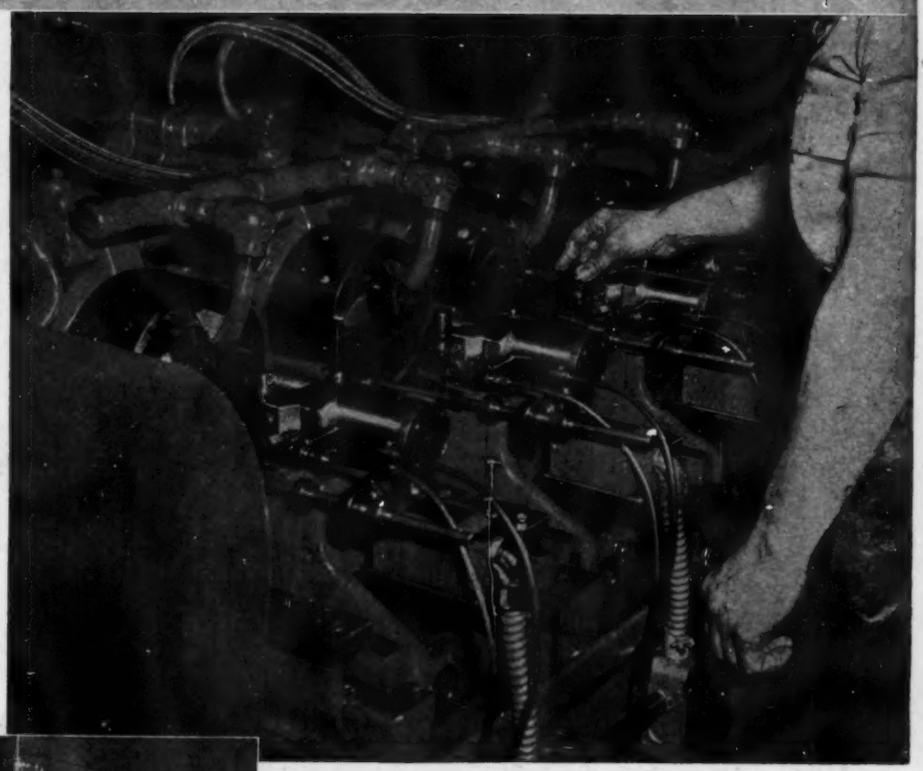
THREADING MACHINE

The Landis 4-Spindle Semi-Automatic Threading Machine is a precision machine designed for threading automotive parts, bolts, studs, rods, etc.

Average production ranges from 500 to 2000 pieces per hour, depending upon diameter and thread length.

The machine illustrated is cutting a 3/8" diameter 24 pitch thread 2-3/16" long on bar stock with a production of approximately 400 pieces (800 threads) per hour, reducing the threading cost 40% over previous methods.

Write for Bulletin No. 88



THE LANDIS CHASER

COMPANY

LANDIS
REG. U.S. TRADE-MARK PAT. OFF.

WAYNESBORO
PENNA., U. S. A.

Operator Output Up 37% Scrap Cut 25%

LANDIS TOOL COMPANY, WAYNESBORO, PENNA.

A large electrical manufacturer who purchased three Landis Tool 10" x 20" Hydraulic Universal grinders for tool room work reported a 37% increase in output and 25% reduction in scrap over a previous machine.

in Tool Room Grinding

Here are some of the features of design that give such performance:

increased output

- Controls grouped for operator convenience.
- Rapid setup for various jobs with graduated swiveling headstock, wheelbase and swivel table, plus combination live and dead spindle headstock.
- Speeds adjustable for maximum output—adjustable speed headstock motor drive and adjustable speed hydraulic table traverse.

reduced scrap

- MICROSPHERE wheel spindle bearings permit closer work tolerances because exact bearing clearance is adjustable.
- Dynamic balance of rotating parts eliminates vibration of rotating parts and assures fine unmarred finishes.
- Hydraulic control permits more exact tolerances because you are free of jarring at reversal or end of cycle.

You may have an entirely different grinding problem. However, you will find the same features that make possible large output and close tolerances on the more than 200 types of grinders produced by Landis Tool.

Our engineers will be glad to assist you with your grinding problem. For more information on this machine request bulletin I 145. 65

optional features

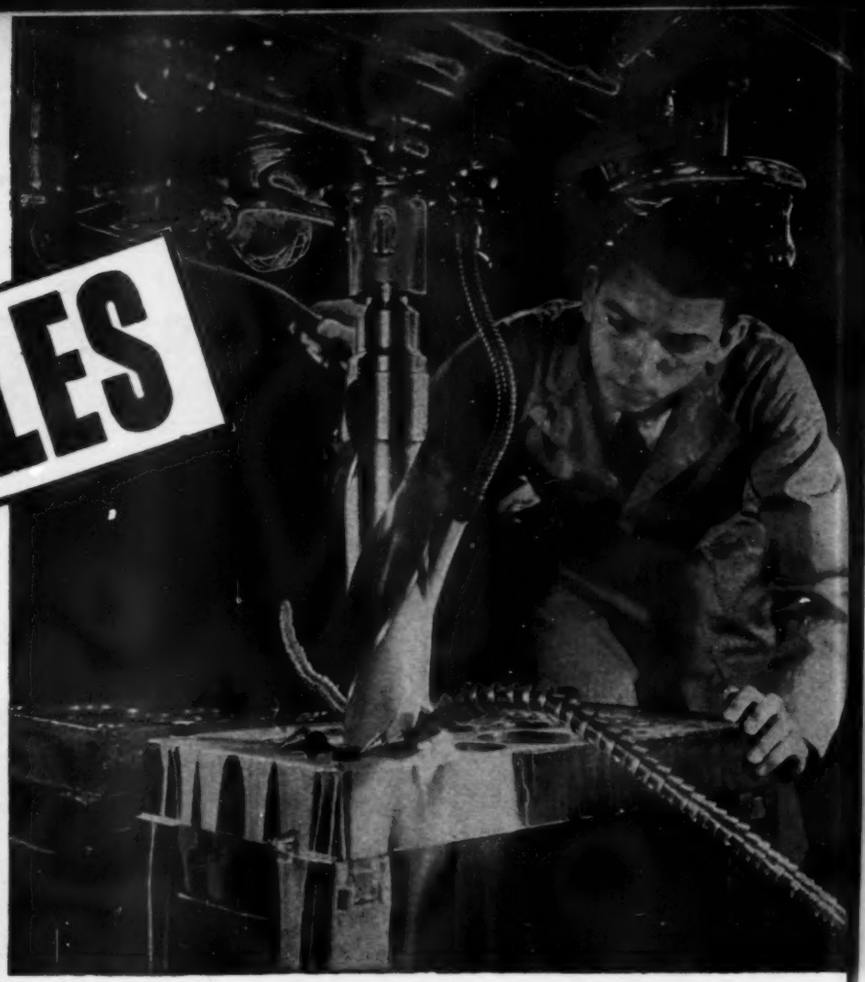
Rotary Magnetic Chuck
Collett Chuck
Double End Wheel Mounting
Wheel Balancing Arbor

standard equipment

Combination Live & Dead Spindle Headstock
Face Plate for Live Spindle Grinding
Water Service
Two Work Rests
Removable Bracket Type Internal Fixture
6" 4 jaw Independent Chuck

LANDIS TOOL
Precision Grinders

BIG HOLES



LITTLE HOLES

It makes no difference — there's an "AMERICAN" for every job.

"AMERICAN" Hole Wizard Radials are meeting the challenge of intensive production without a whimper. Day in and day out in the production shops throughout the country they are drilling, boring and tapping at top speed and at the same time maintaining amazing standards of accuracy.

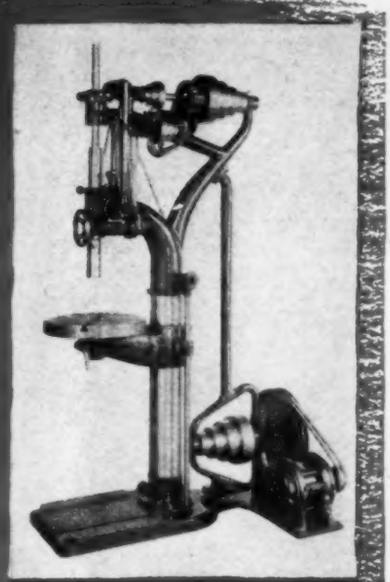
Manufacturing shops that have established enviable records for low cost production are using "AMERICAN" Radials.

THE AMERICAN TOOL WORKS CO.

Cincinnati, Ohio, U. S. A.

Lathes and Radial Drills

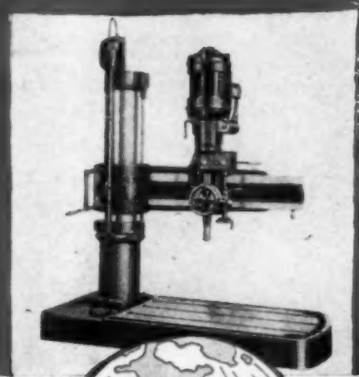
THEIR HATS ARE OFF TO C-O . . . A NAME THEY KNOW!



Operater and management man alike say, "A Canedy-Otto Drill Press Is TOPS!" Easy operation, accuracy and speed appeal to the operator. Its low initial and maintenance cost, its high production records mean greater profit for management. Select all your standard drill press needs from the World's Most Complete Drill Press Line — the CANEDY-OTTO line. Write today for insert No. 90, describing and illustrating our complete line.

8-SPEED — 21" STATIONARY HEAD FLOOR DRILL

A 1½" capacity, single spindle drill of semi-cast one piece steel construction with lower column turned and ground, equipped with sleeve type bearings except in spindle where ball thrust bearings are provided. Equipped with back gears and power feed, ratchet type lever feed, wheel feed and automatic stop. Semi-cast steel table and base, well ribbed, tee-slotted, accurately machined. Table revolves on column. Available with either tight or loose pulley drive for power take-off, electric Vee belt, or geared motor drive.



8-12 SPEED MOTOR SPINDLE RADIAL DRILL

1¾" capacity, with 3 ft., 4 ft., and 5 ft. arm. Simply designed, easy to operate, for close precision work. Powered by 2 H.P. constant horsepower motor, magnetically controlled, 1200 RPM and 1800 RPM. 4 rates of power feed. Automatic trip. Ideal for tapping.

21" BOX COLUMN SLIDING HEAD FLOOR DRILL

1½" capacity, available in 1-, 2-, 3-, 4- and 6-spindle models, of full ball and Timken roller bearing design. 8 step Vee belt drive on tilting motor bracket gives sixteen spindle speeds. Positive geared power feed. Automatic stop. Also operates through lever, power feed or worm wheel feed. Accurately machined column, base and adjustable table.

C THE WORLD OVER O

Write today for insert No. 90, describing and illustrating the World's Most Complete Drill Press Line — the Canedy-Otto line of radial drills, sensitive drills, upright drills, hi-speed drills and special drilling machines.

CANEDY-OTTO MFG. CO., CHICAGO HEIGHTS, ILL

MORSE All Types

No. 2039. Spiral Fluted Taps: High Speed Steel (Fractional Sizes)

No. 2065. Spiral Fluted Taps: High Speed Steel (Machine Screw Sizes)
Designed for use in aluminum, die-cast metal, soft brass, copper, and stringy metals.

No. 2040. Hand Taps: High Speed Steel—Cut Threads (Fractional Sizes)

No. 2046. Hand Taps: High Speed Steel—Ground Threads (Fractional Sizes)

No. 2066. Machine Screw Taps: High Speed Steel—Cut Threads (Machine Screw Sizes)

No. 2068. Machine Screw Taps: High Speed Steel—Ground Threads (Machine Screw Sizes)

Designed for use by hand and by machine power.

No. 2115. Taper Pipe Taps: High Speed Steel—Cut Threads
No. 2119. Taper Pipe Taps: High Speed Steel—Ground Threads
Used for tapping pipe fittings, boilers and boiler plates, etc.

No. 2115. Taper Pipe Taps: High Speed Steel—Interrupted Threads
Used in copper and stringy materials where taps tend to tear.

No. 2082. Pulley Taps: High Speed Steel—Ground Threads
Same as No. 2046 Hand Taps, but with a long shank. For use in tapping set-screw holes in pulleys with hubs. Also for tapping oil-cup holes.

E MAKES
s of Taps... *to give you Smooth, Strong Threads in any material*

No. 2045. Spiral Pointed Hand Taps: High Speed Steel—Cut Threads (Fractional Sizes)

No. 2047. Spiral Pointed Hand Taps: High Speed Steel—Ground Threads (Fractional Sizes)

No. 2067. Spiral Pointed Machine Screw Taps: High Speed Steel—Cut Threads (Machine Screw Sizes)

No. 2070. Spiral Pointed Machine Screw Taps: High Speed Steel—Ground Threads (Machine Screw Sizes)

Designed for use in sheet metal. Work very well in machine tapping of thru holes in all types of materials. This type of tap forces the chips ahead of the tap, so it should not be used in tapping blind holes unless sufficient chip clearance is allowed in the bottom of the hole.

Name your material—and Morse will supply you with the tap which has the right specifications for your particular job. The Morse line of taps is *really comprehensive* . . . embracing top-quality cut-thread or ground-thread taps of every type, both standard and special, to meet *your* requirements.

What's more, when you use Morse taps, you're sure of getting *smooth, strong* threads . . . threads which hold because they're cut with precision cutting tools of the highest quality. You'll get no clogging, no damaged threads . . . and you'll get faster tapping on every job.

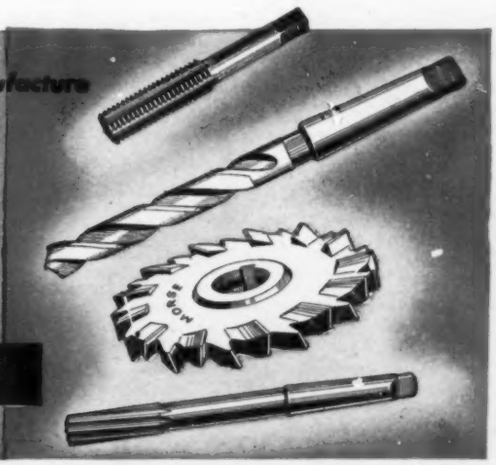
So make a date today with your Industrial Supply Distributor. He'll be glad to cooperate in securing a Morse recommendation, and will *save you money* by getting the exact tap you need.

Accuracy, Quality, Uniformity: the MORSE Code of Cutting-Tool Manufacture

MORSE TWIST DRILL & MACHINE COMPANY

The Original Manufacturer of Twist Drills

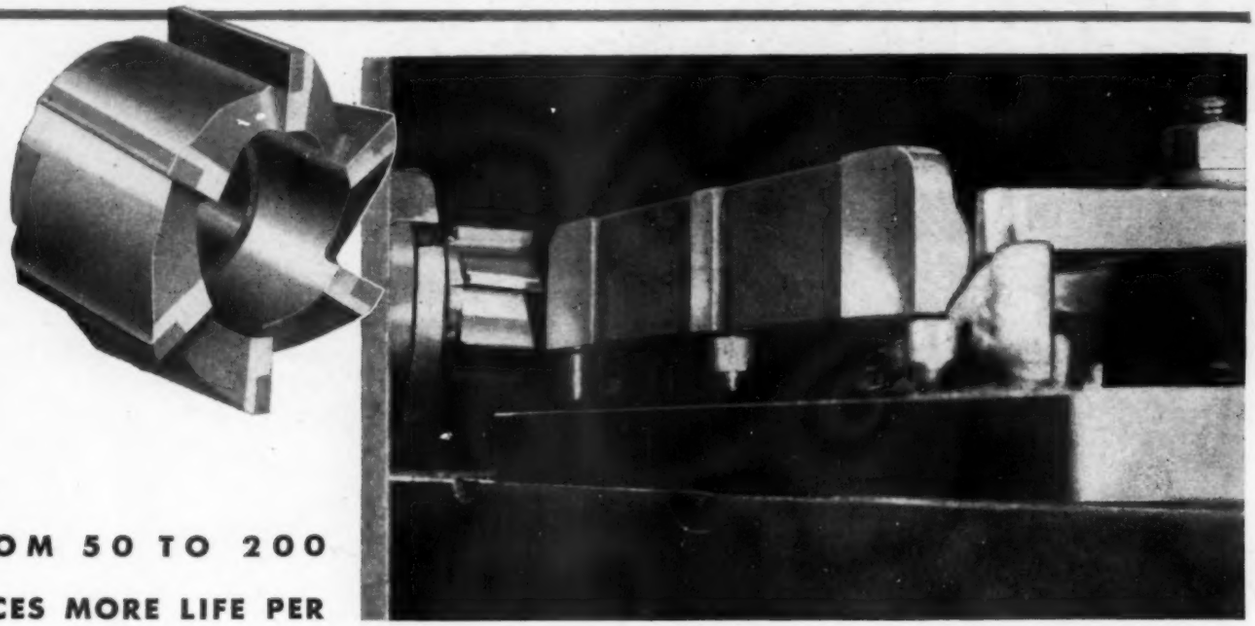
NEW BEDFORD, MASSACHUSETTS



NEW YORK STORE: 130 LAFAYETTE ST. • CHICAGO STORE: 570 WEST RANDOLPH ST. • SAN FRANCISCO STORE: 1180 FOLSOM ST.

WHEN YOU WANT MORE TOOL LIFE

Try B-C *Carbide Tipped Milling Cutters*



FROM 50 TO 200 PIECES MORE LIFE PER SHARPENING. B-C TIP MOUNTING REDUCES BREAKAGE CAUSED BY HARD SPOTS

TROUBLE SHOOTING? Tool Supervisors:— Production Superintendents:— If you are having difficulty smoothing out certain milling problems, get a copy of MILLING CUTTER DATA. Descriptions of actual field installations using B-C Milling Cutters will suggest feeds, speeds, tooling arrangements and efficient methods for a variety of cuts. A note on your company letterhead will bring a copy promptly.

CUTTER PERFORMANCE FACTS

Operation — Face mill 3 bosses removing ¼" stock, center boss 2" x 1", end bosses 2" x 2½".

Material — Medium cast-iron.

Cutters — B-C Carbide Tipped Shell End Mills, 2¼" x 1½" x 1¼", slight spiral gashes.

	HSS Cutter	C-T Cutter
Feed	3" to 4"/ min.	15"/ min.
Speed	40 S.F.M.	240 S.F.M.
Floor-to-floor	30-40 in 10 hrs.	90 in 10 hrs.
Tool Life	50 pcs. per sharpening.	200 pcs. per sharpening.

This job was slow and costly because of low tool life and high cutter breakage. Three intermittent bosses on cast-iron brackets required the removal of 1¼" stock. Hard spots and abrasive action of the material combined to shorten tool life by nicking and chipping the cutting edges.

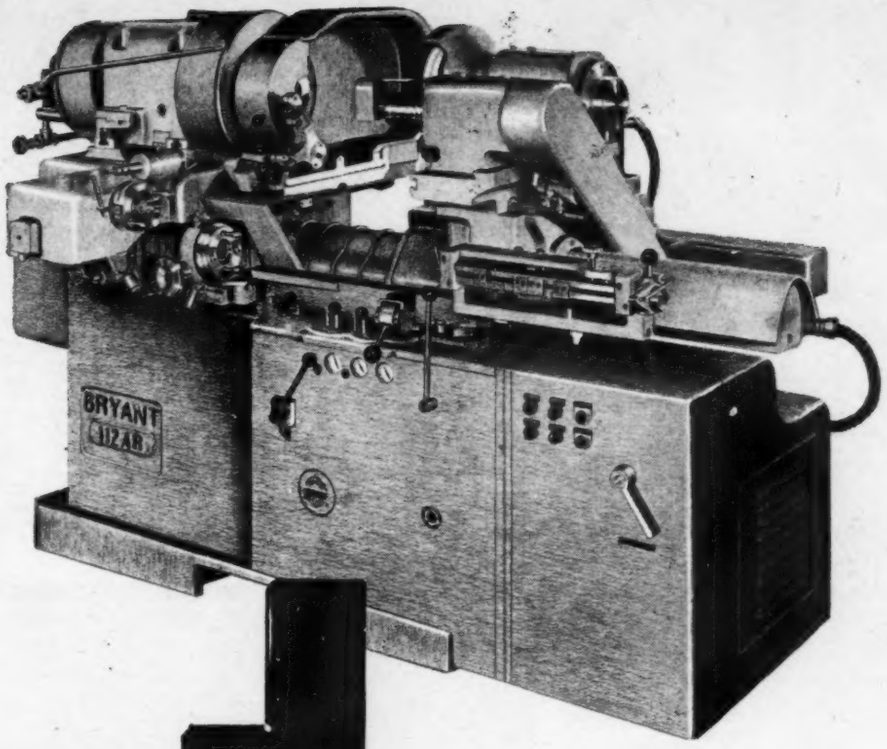
After careful analysis of all factors, Barber-Colman Cutter Engineers recommended the use of carbide tipped shell end mills, with fewer teeth and slight-spiral gashes. Today, experience-tested B-C tip mountings and heat-treated high speed steel bodies are successfully withstanding the shock of the hard spots, and tool life and production are increased approximately 400%.

If your job conditions are suited to the use of carbides, consult a Barber-Colman representative on your next production problem. Experience the satisfaction that this manufacturer had in improving operation and increasing production.

MODERN MACHINES WITH ORDINARY BARBER B-C COLMAN CUTTING TOOLS ARE NOT FULLY EFFICIENT

Barber-Colman Company

GENERAL OFFICES AND PLANT 111 LOOMIS ST. ROCKFORD, ILLINOIS U.S.A.



For Grinding INSIDE and OUTSIDE Diameters in a Single Chucking

The new No. 112-AR Bryant fills the need for a fast, precise machine for grinding internal and external diameters in a single chucking of the work — for reducing production time on parts where concentricity is an important factor. The 112-AR has two wheelheads carried on a common longitudinal slide. The workhead indexes from one spindle position to the other on a transverse slide, and is controlled by separate feedscrews at each of these positions. This machine will grind two separate diameters, one of which may be an outside diameter, as well as the face of the work. For facing operations, a turret stop and axial feedscrew are provided.

A similar machine, the new No. 112-AH, is designed for grinding one inside diameter and a face to extremely close squareness limits. This machine has a feedscrew for internal diameter control and an axial feedscrew for facing operations.

These two hydraulically operated grinders have a maximum swing of 16" and grinding stroke of 9"; workhead is adjustable to grind an included angle of 90°.

THE NEW NO. 112-AR

ANOTHER BRYANT POSTWAR DEVELOPMENT

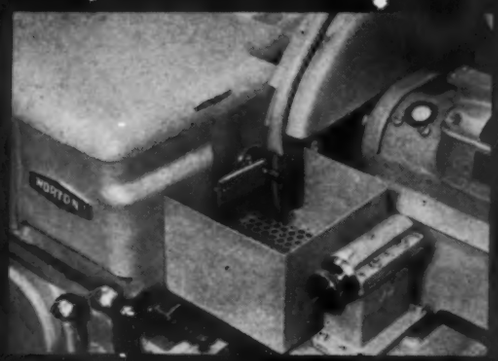
Send for the Man from

BRYANT CHUCKING GRINDER CO.

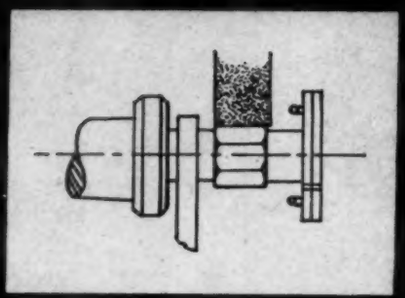
SPRINGFIELD, VERMONT, U. S. A.

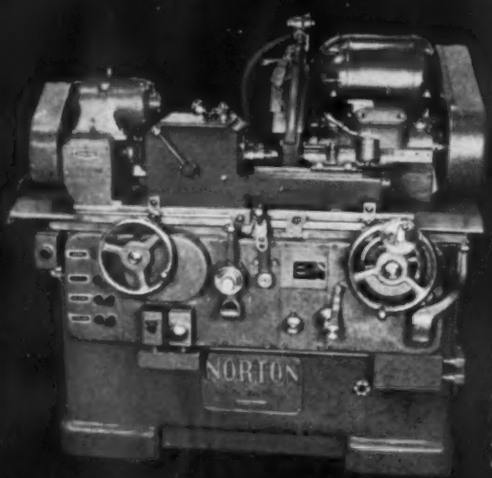
BRYANT

Doing Cam and Shape Grinding?

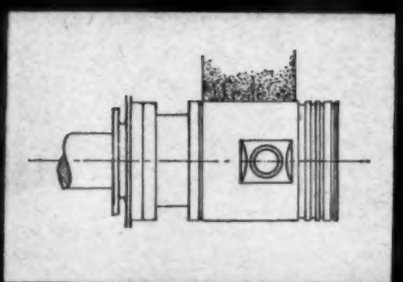


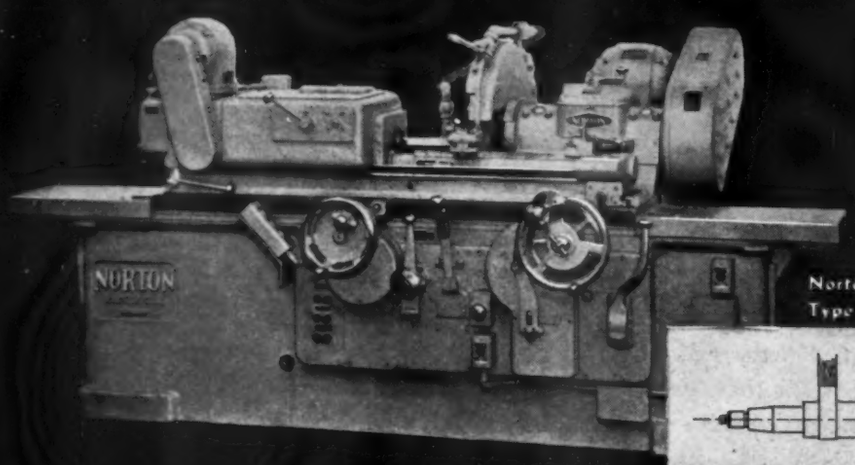
Norton Distributor Cam Grinding Attachment on 6" Type C Semiautomatic Cylindrical Grinder.



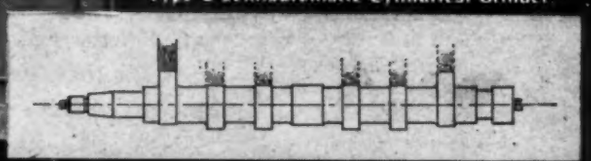


Norton 4 x 7" Cam Grinding Attachment on a 6 x 15" Type C Semiautomatic Cylindrical Grinder.





Norton 5x24" Cam-O-Unit on a 10x36" Type C Semiautomatic Cylindrical Grinder.



NORTON GRINDERS
and Lappers

NORTON Has a Versatile Line of Cam Grinding Equipment

MANY mechanisms in production today demand cam and shape contours ground to exacting requirements — both for accuracy and finish. Norton's cam and shape equipment has been made to handle a large variety of work — ranging from large Diesel camshafts to tiny shafts for motion picture projectors.

Outstanding features of Norton Cam and Shape Grinding Equipment are:

- **Easy Operation**—adjustments few and easily made
- **Rapid Operation**—gives low cost production
- **Adaptability**—suitable for large variety of requirements
- **Dependability**—long-proven Norton design

If you have a cam or shape grinding problem put it up to the Norton staff of cam specialists. Write for catalog #2053-6 on Norton Cam and Shape Grinding Equipment or Catalog #2262 on the Norton Cam-O-Matic Grinder for automotive type camshafts.

NORTON COMPANY, WORCESTER 6, MASS.

Distributors in All Principal Cities

M-541

ROLL FORMING CAMS

DISTRIBUTOR CAMS

ECCENTRICS

AIRCRAFT CAMSHAFTS (Reentrant Curves)

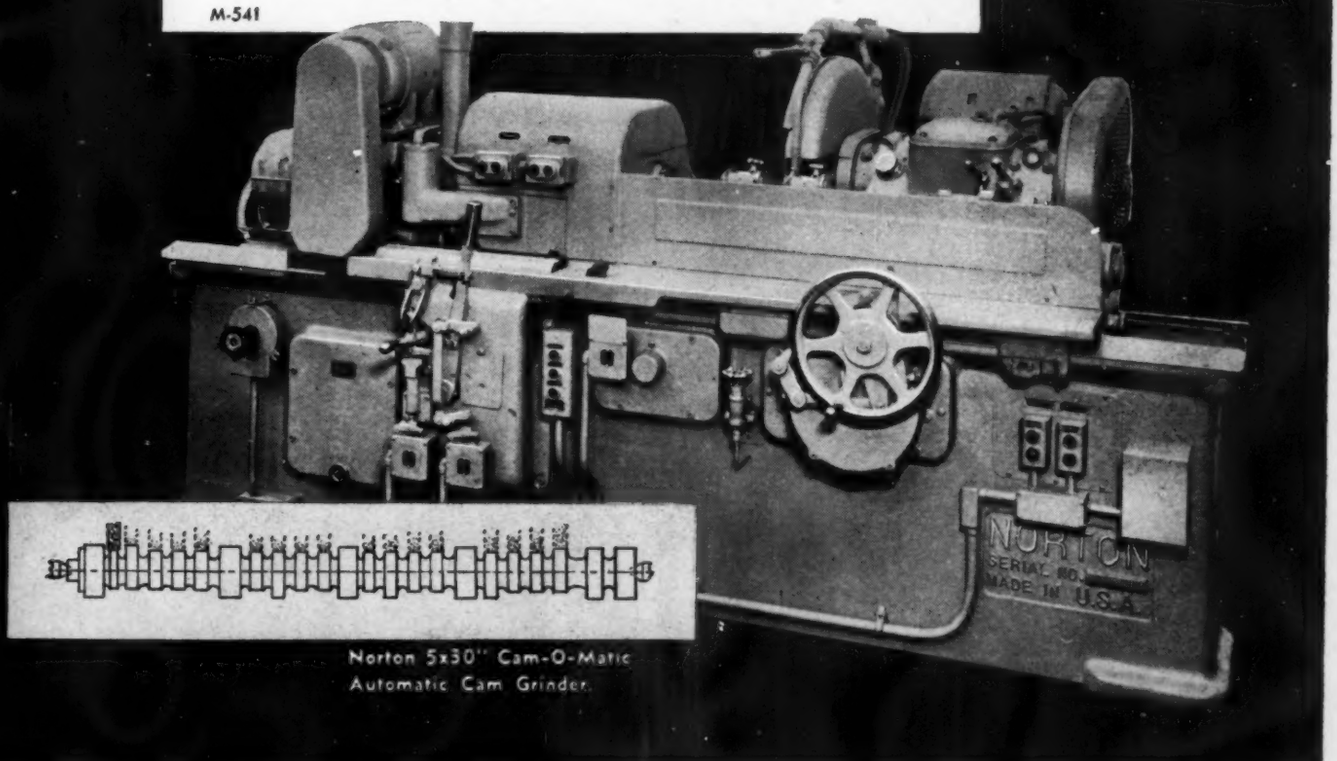
DIESEL CAMS

ELIPTICAL PISTONS

AUTOMOTIVE CAMSHAFTS

SINGLE CAMS

SMALL ENGINE CAMSHAFTS



Norton 5x30" Cam-O-Matic Automatic Cam Grinder.

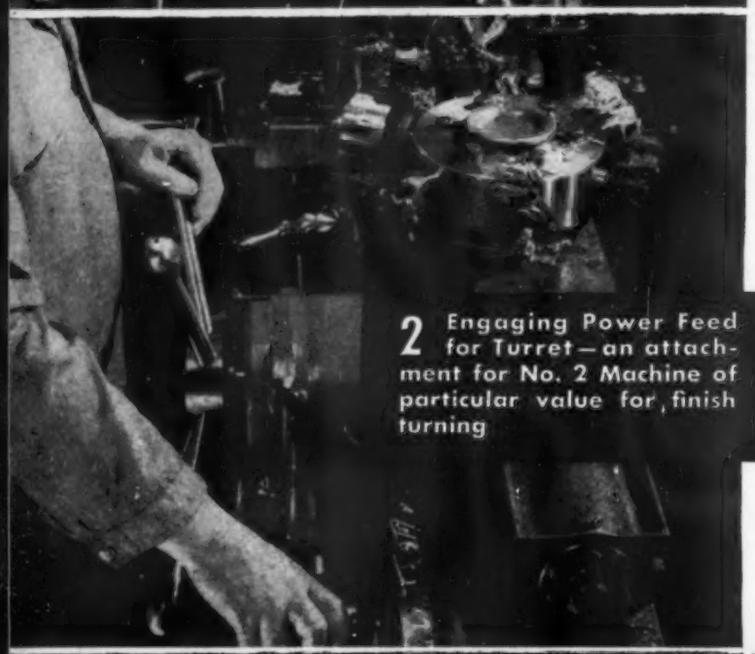
1 A tap of the hand opens chuck, feeds bar and closes chuck . . . all in ¾ second

Short Runs

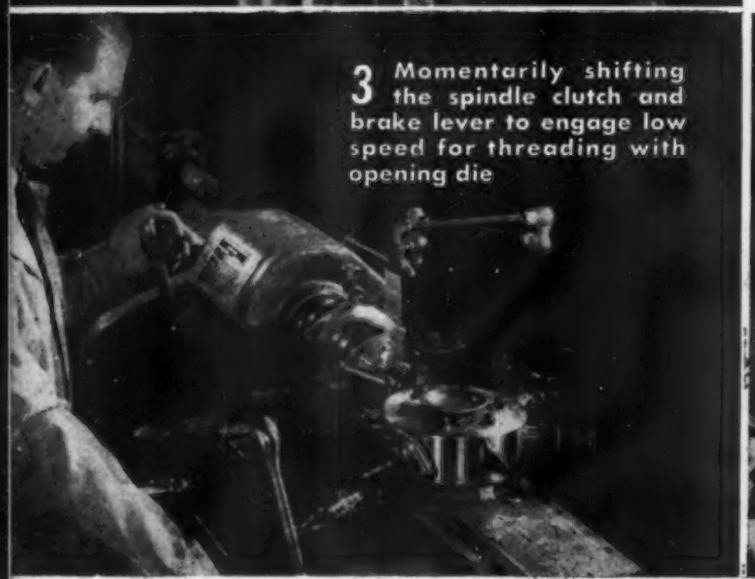
on these handy WIRE FEED

You'll appreciate their operating ease with minimum number of controls — so profitable on short runs

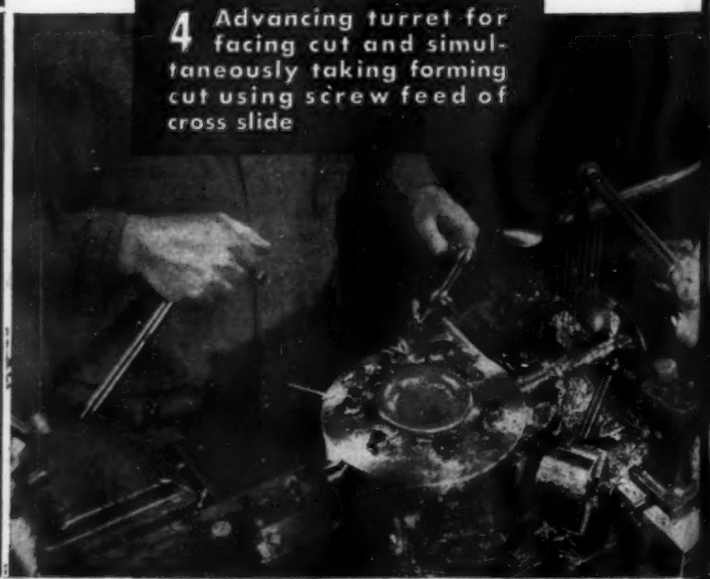
Full facilities for completing pieces from bar stock



2 Engaging Power Feed for Turret — an attachment for No. 2 Machine of particular value for finish turning



3 Momentarily shifting the spindle clutch and brake lever to engage low speed for threading with opening die

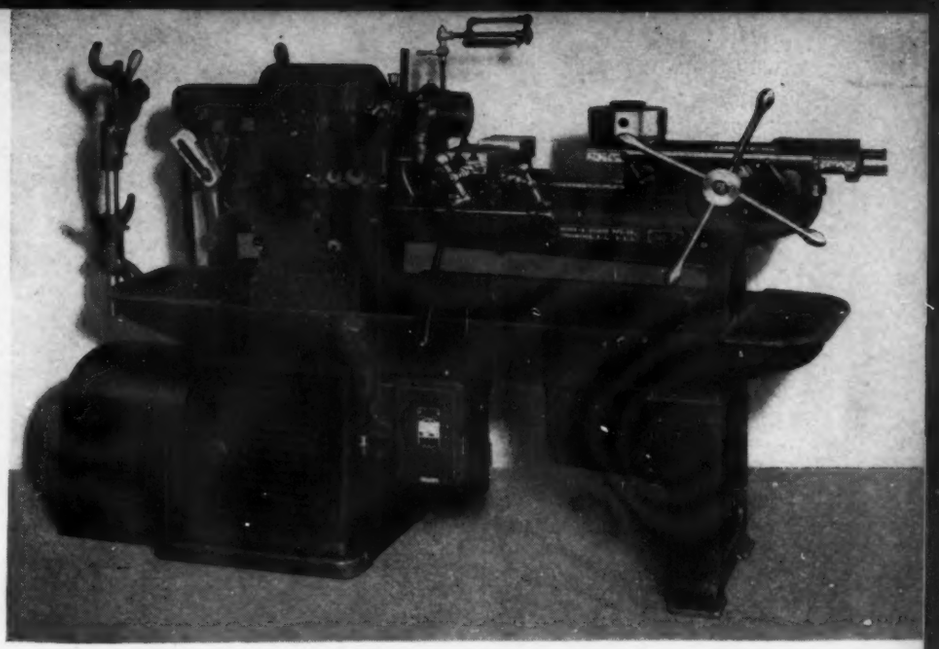


4 Advancing turret for facing cut and simultaneously taking forming cut using screw feed of cross slide

BROWN &

at Fast Production

SCREW MACHINES



One lever controls spindle — forward, backward and brake

Cross slide has lever feed for quick action. No. 2 Machine also has screw feed

20 spindle speeds — efficient high speeds in proper relation to slow threading speeds — ranging from 4500 to 220 r.p.m. on No. 0, 3620 to 175 r.p.m. on No. 1 and 2485 to 125 r.p.m. on No. 2

Adjustable stop for each turret tool

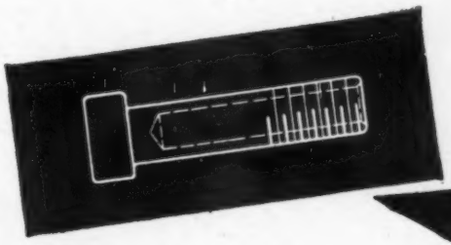
★ No. 0 Machine takes stock to ⅜" dia. (⅝" for light work).

★ No. 1 Machine takes stock to ⅝" dia. (⅞" for light work).

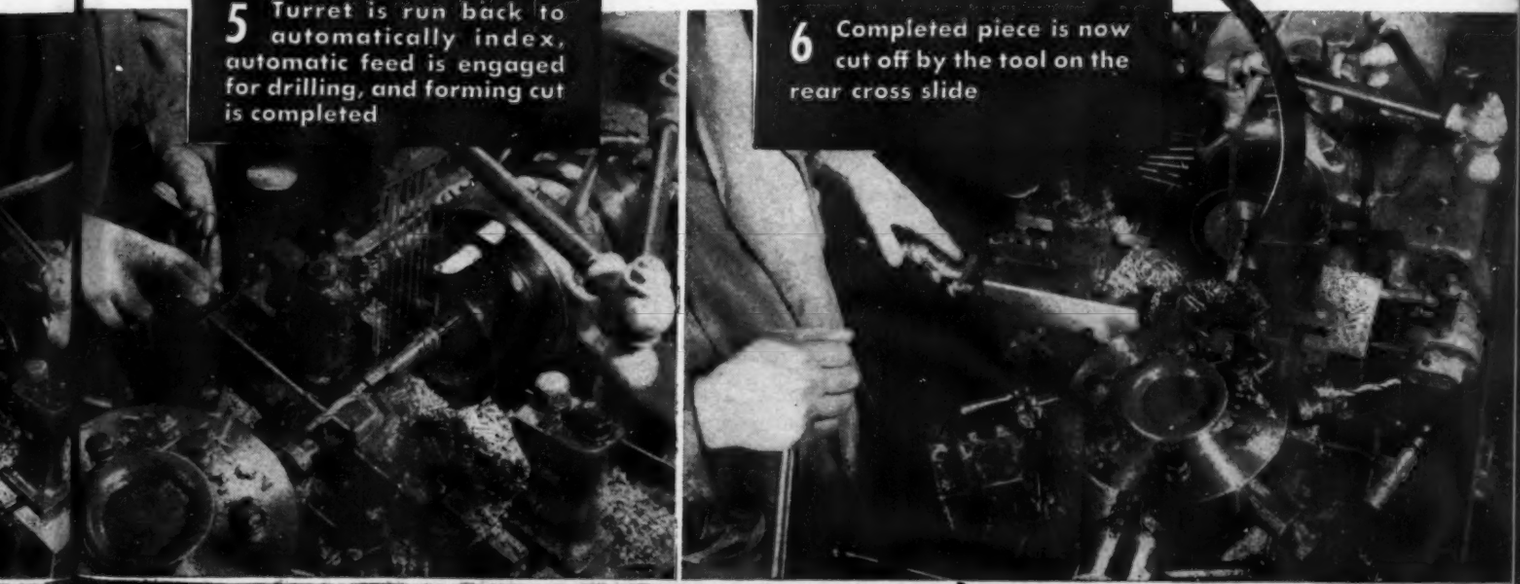
★ No. 2 Machine (shown) takes stock to 1" dia. (1¼" for light work).

Ask for Booklet giving details

BROWN & SHARPE MFG. CO.
Providence 1, R. I., U. S. A.



. . . and the machine is quickly set up to perform **second operations** at the same high productive capacity.

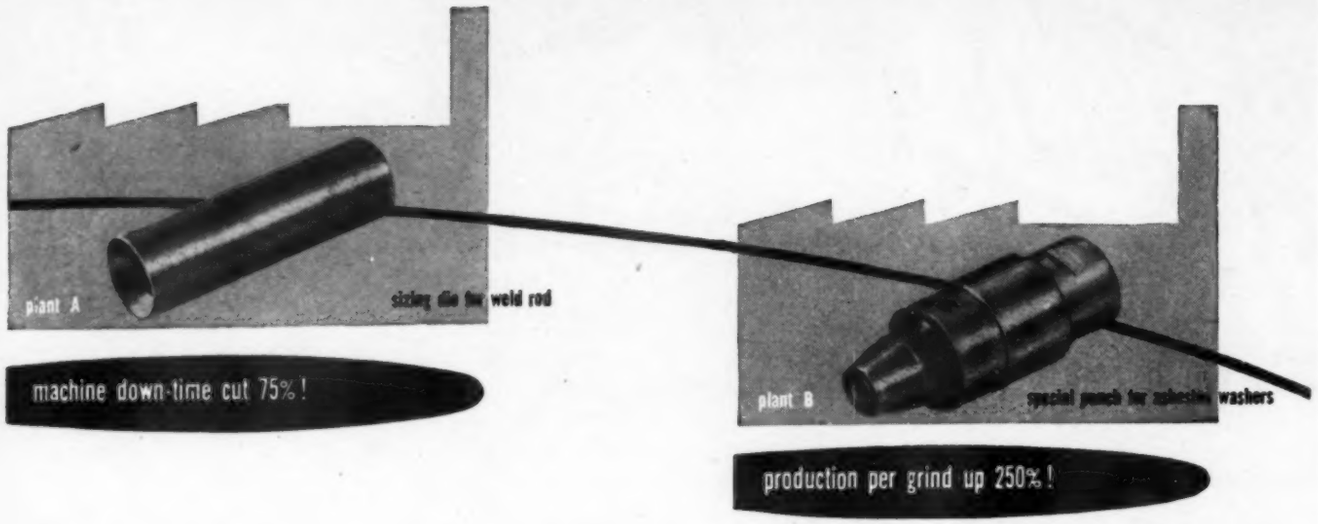


5 Turret is run back to automatically index, automatic feed is engaged for drilling, and forming cut is completed

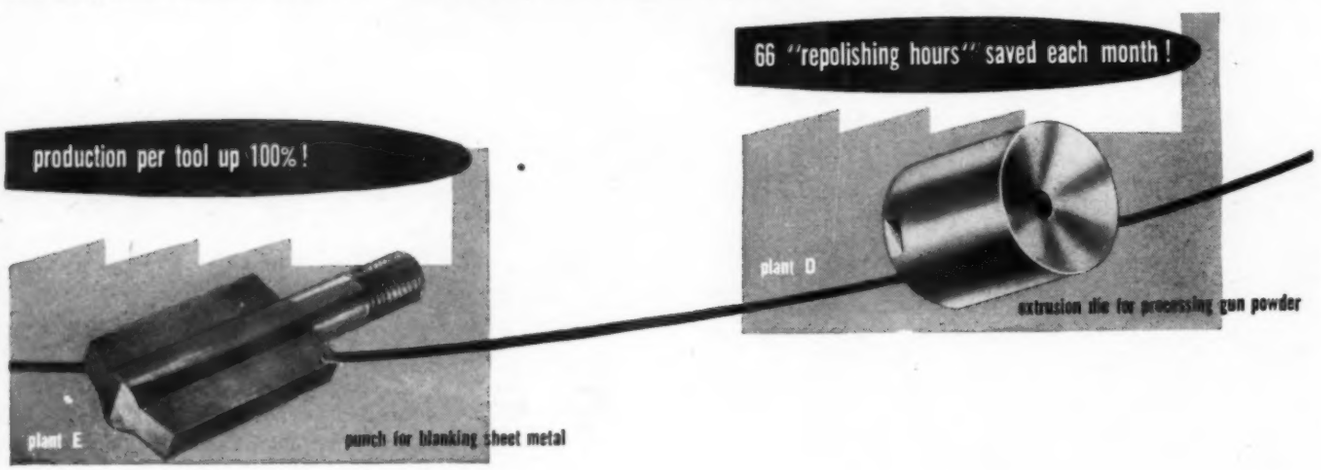
6 Completed piece is now cut off by the tool on the rear cross slide

BROWN & SHARPE

B·S



These Plants are Cutting Tool Costs, Boosting Machine Output - - *you can, too!*

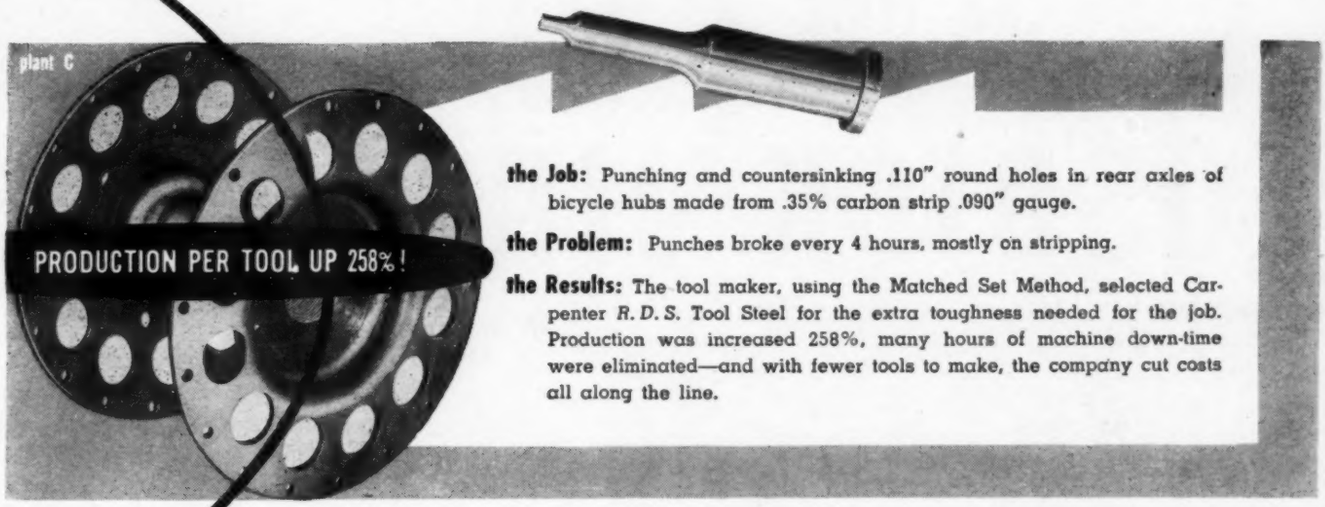

66 "repolishing hours" saved each month!
plant D
extrusion die for processing gun powder
production per tool up 100%!
plant E
punch for blanking sheet metal

THE CARPENTER STEEL COMPANY, 109 W. Bern Street, Reading, Pa.

How to Get Tools that Produce More Per Grind, Reduce Machine Down-Time

Know exactly *how* your tools are going to meet the "on-the-job" test—and know it before they're made! Get better tools that produce more per grind, keep turning out piece after piece—tools that slash costly regrinding and replacement time to a minimum. To do that, use the tried and proved Carpenter Matched Set Method of tool steel selection. Here's how you can cut tooling costs—how you can boost machine output—right now.

The Carpenter Matched Set Method helps you quickly select and properly use the right tool steel for best results. It simplifies your tool steel selection problems. And once you've selected the proper steel, you *know* you're right —you know you've got the "go-ahead" signal to make tools that stay on the job longer, produce more per grind—cut unit costs!



the Job: Punching and countersinking .110" round holes in rear axles of bicycle hubs made from .35% carbon strip .090" gauge.

the Problem: Punches broke every 4 hours, mostly on stripping.

the Results: The tool maker, using the Matched Set Method, selected Carpenter *R. D. S.* Tool Steel for the extra toughness needed for the job. Production was increased 258%, many hours of machine down-time were eliminated—and with fewer tools to make, the company cut costs all along the line.

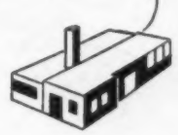
Contact your Carpenter representative today. He can give you all the information you need to put the Matched Set Method to work in your plant. Just call your nearby Carpenter Warehouse or Distributor, now.

Call YOUR NEARBY CARPENTER WAREHOUSE OR DISTRIBUTOR TODAY FOR FAST DELIVERY OF --

Carpenter MATCHED TOOL STEELS

Baltimore	Cleveland	Los Angeles	San Francisco
Birmingham, Ala.	Dayton	New York	Seattle
Boston	Detroit	Philadelphia	Worcester, Mass.
Buffalo	Hartford	Portland, Ore.	*In Canada:*
Chicago	Houston	Providence	Toronto and
Cincinnati	Indianapolis	St. Louis	Montreal

See Your Classified Telephone Directory



Carpenter

MATCHED TOOL STEELS

100% ACID DISC-INSPECTED

WARRANTED CLEAN DIOK SOUND UNIFORM

COMPLICATED PATTERNS MADE ACCURATELY IN LESS TIME ON FOSDICK JIG BORER

● The extreme accuracy and versatility of this machine makes it particularly suited to tool room and tool and die shop operations. Chiefly because that type of work requires the utmost accuracy and the runs are usually very short.

As an example take the jobs shown. These patterns must meet close tolerances and at the same time must be completed within a reasonable length of time so that costs are not prohibitive.

The Fosdick Jig Borer is ideal for work of this nature. It provides the necessary accuracy—ease of control—and flexibility of operation essential to low cost die, tool and pattern work.

Its rigidity assures precision and its simplicity of operation permits the average drill press operator to produce accurate work in a very short time.

On your precision jobs it will pay you to consider the many advantages offered in this economical machine. Full details available in our new jig borer bulletin J. B. A. No. 5.

Write for yours today

THE Fosdick MACHINE TOOL COMPANY
CINCINNATI 23, OHIO

The CONE AUTOMATIC MACHINE COMPANY

sees many

GOOD THINGS AHEAD

It is reported that . . . . . .

"Styrofoam," styron plastic expanded 40 times into a multicellular, foamlike mass, is being offered by Dow Chemical Co., as an insulating material.

get ready with CONE for tomorrow

Soft enough to be machined, punched or drawn, two new magnet metals, Cunico and Cunife, have been developed by General Electric Co.

be ready with CONE for today

Large and complex glass-to-metal seals are made at Westinghouse Lamp Division by spraying liquid-suspended powdered glass on hot Kovar metal.

get ready with CONE for tomorrow

Especially intended to prevent shifting of loads in freight cars and trucks, Load-Lok, a glue made by National Adhesives, has high sheer strength, but can be broken at will in unloading.

be ready with CONE for today

The new Lycoming XR-7755, a 36-cylinder radial, develops 5,000 h.p. at 2,600 r.p.m., and is said to be the world's most powerful aircraft engine.

get ready with CONE for tomorrow

The U. S. Department of Agriculture is now operating an experimental alcohol plant at Peoria with a capacity of 500 gallons per day from farm waste.

be ready with CONE for today

U. S. Rubber Co. is selling a lighter-than-cork cellular rubber that is resistant to moisture, fire, rot, acid, oil, vermin and termites.

get ready with CONE for tomorrow

Union Pacific R. R. has placed orders for 64 diesel-electric locomotives. This is said to be the largest order for diesel-electric locomotives in railroad history.

Atlantic Coast Fisheries Co. has developed a machine with which one operator can fillet haddock at the rate of 45 per minute.

get ready with CONE for tomorrow

Barber-Colman Co. has a new machine to automatically perform threading-up operations on textile looms by the use of punched cards.

be ready with CONE for today

The Pennsylvania Coal Co. will supply its miners with music by means of loud speakers at the top and bottom of the mine shaft.

get ready with CONE for tomorrow

A simple change in tread design makes the new Firestone Tractor Tire out-pull previous tires.

The Spang-Chalfant Div. of National Supply Co. in Pittsburgh is making steel pipe with a baked-on phenolic plastic coating which has been tested for several years in the oil fields.

be ready with CONE for today

Hobart Bros. Co. has designed a self-propelled and self-powered mobile arc welder for use in railway yards, oil refineries and large factories.

get ready with CONE for tomorrow

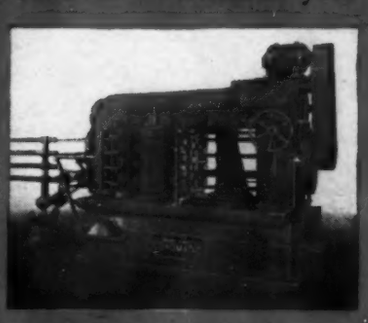
The thumbnail size silicon crystals made by Sylvania Electric Products can be used as first detectors in superheterodyne receivers, and unlike tubes, require little space and no filament supply.

be ready with CONE for today

The Locomotive Development Committee of Bituminous Coal Research expects to conduct on-the-rail tests of its coal-fired gas turbine locomotive this summer.

FOLLOW THESE PAGES FOR NEWS OF PROGRESSIVE PRODUCTION

Four parts in the time for one is profitable production. The pieces shown are made, four at a time, from SAE 1112 in 5½ seconds each. Investigate profit possibilities of the Conomatic Vertical in your shop. Write for information.

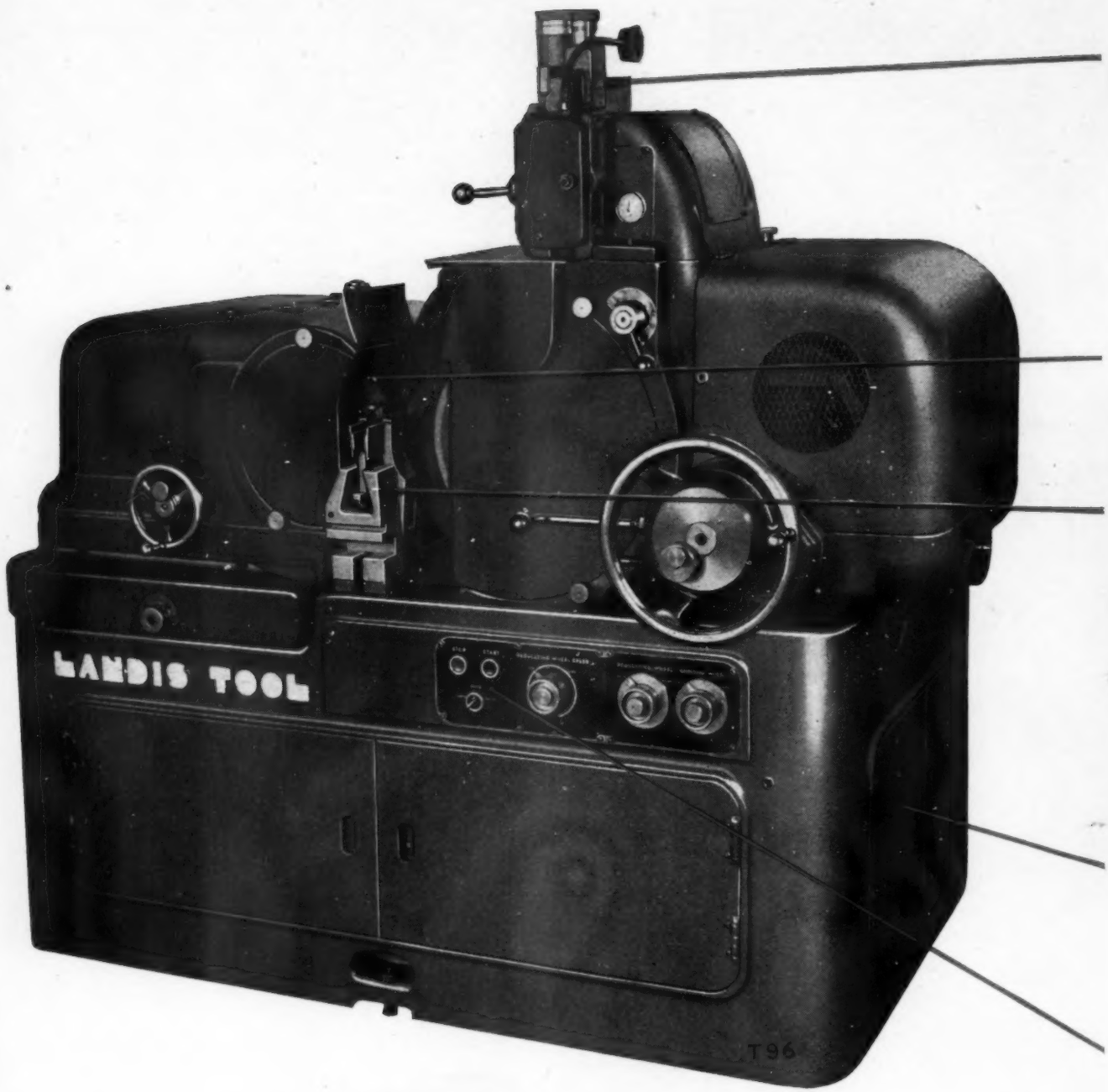


Ask your CONE *representative to show you our new color motion picture*

CONE

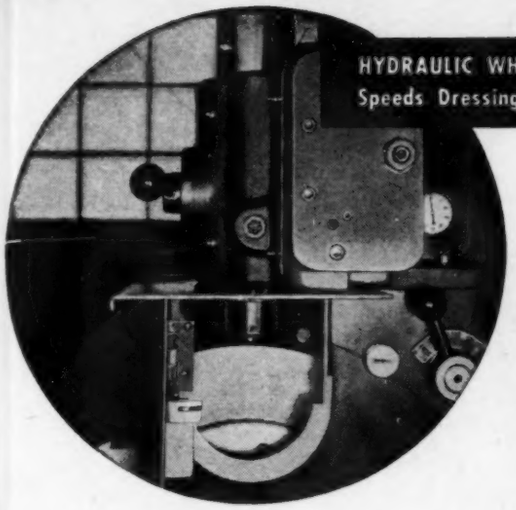
AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U.S.A.

39



LANDIS TOOL
Precision Grinders

Request Catalog T-44 for details

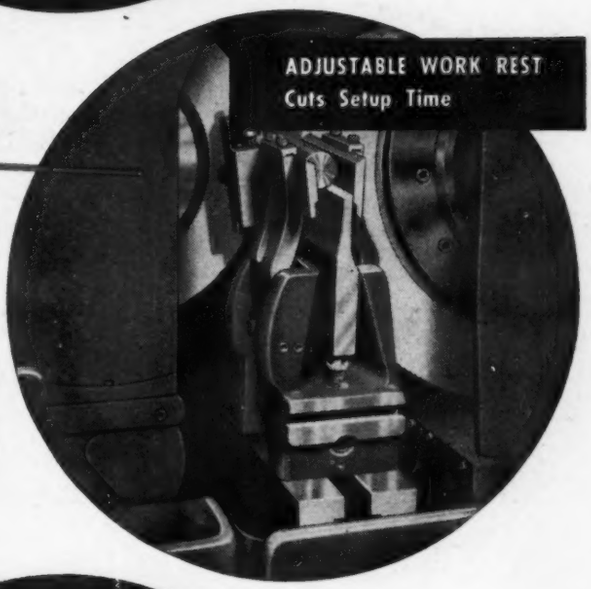


HYDRAULIC WHEEL DRESSER
Speeds Dressing

REGULATING WHEEL Dressed
Rapidly At Point Of Contact

LANDIS TOOL

Centerless Grinder Design Features for *high Production* and *easy Maintenance*



ADJUSTABLE WORK REST
Cuts Setup Time

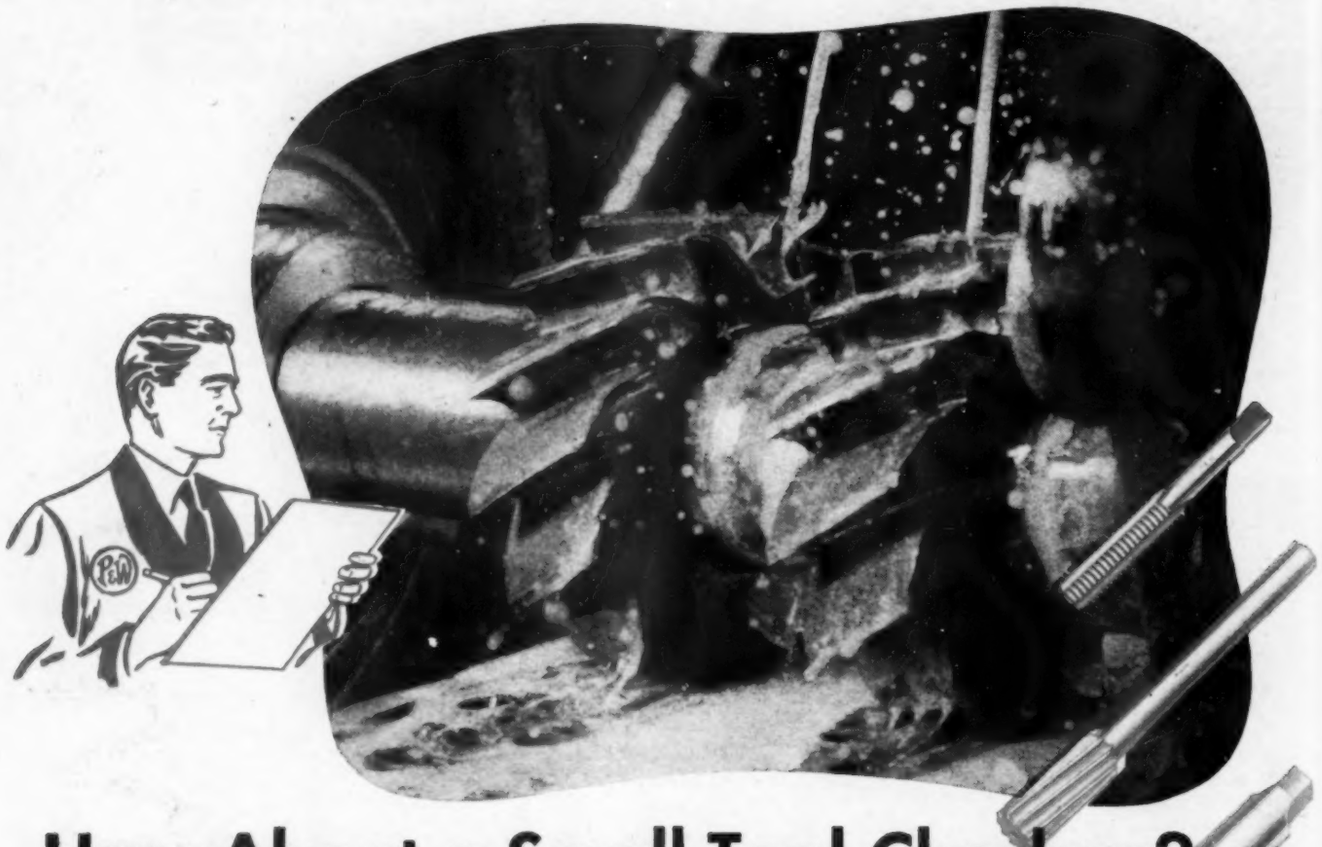
ACCESSIBLE OPERATING PARTS
Simplify Maintenance

CENTRALIZED CONTROLS
Reduce Fatigue

61

LANDIS TOOL COMPANY, WAYNESBORO, PENNA.

Competition Ahead!

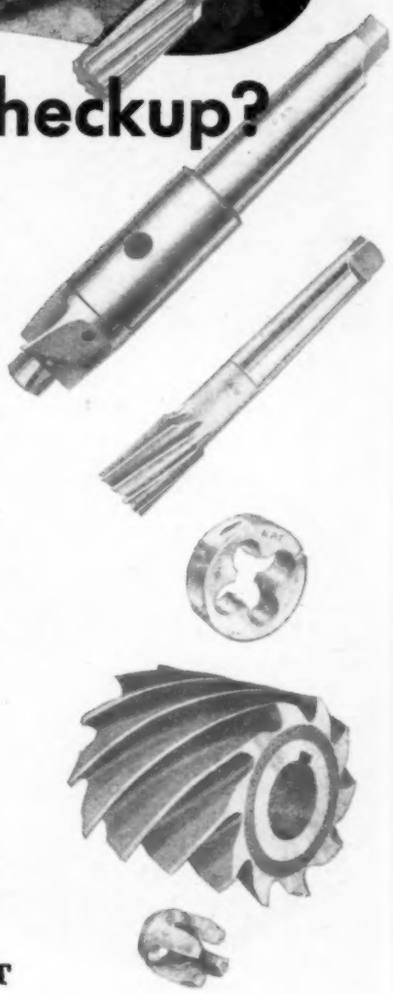


How About a Small Tool Checkup?

No room for inefficient cutting tools in the competitive battle ahead. High labor and material costs won't permit it. Manufacturing survival—even jobs—depend on efficient, fast-cutting tools that can take it on the toughest jobs.

Call in your Pratt & Whitney Engineer. As a starter, let him check up on your small tool performance. He's a specialist in speeding output at low cost. He knows how to survey a production setup against known standards of efficiency. At his finger tips are specifications on materials to be cut and the tools to cut them; data on cutter and tap performance that can save you money. To handle the toughest problems, he'll call upon the resources of Pratt & Whitney engineering and research.

He'll study your complete small tool picture and then give you a report that will show you how to cut production corners . . . send production up and costs down. And his services will cost you nothing. Here's how to get them—just write us a letter. No obligation—naturally. Ask for a fact-packed P&W Condensed Catalogue while you're writing.



PRATT & WHITNEY

Division Niles-Bement-Pond Company

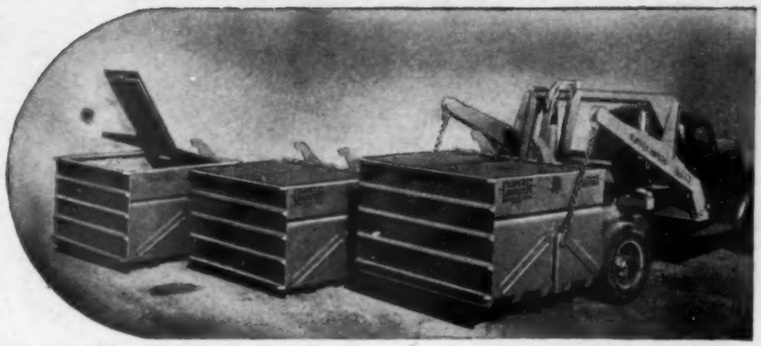
WEST HARTFORD 1, CONNECTICUT

Put It On Your Products NOW!

When you identify your machines as "Timken Bearing Equipped" you greatly increase their value in the eyes of the prospective buyer; for the use of Timken Tapered Roller Bearings has been associated with top-notch equipment of all kinds for so long that the "Timken Bearing Equipped" symbol has become a Symbol of Quality wherever it appears. Thus Timken Bearings make better machines and *better-selling* machines. If you are using Timken Bearings, why "hide your light under a bushel"? Tell the world about it. It's a sales plus you can't afford to overlook. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

ONE TRUCK SERVES 20 BODIES IN THIS PLANT



Another Dempster Development For Industrial Materials Handling

★ Another typical example of how the Dempster-Dumpster is saving time, manpower, trucks, tires, and gas in leading industrial plants of almost every classification.

In this case, twenty standard Dempster-Dumpster drop-bottom bodies of 6 cu. yd. capacity each, equipped with special twin, self-balancing, spring hinged lids, are spotted throughout one of America's leading factories. A few are placed in convenient spots for receiving waste and rubbish. Others are placed at strategic points for recovering metal shavings. As each body is filled, forked truck conveys loaded body to convenient point where truck, equipped with the Dempster-Dumpster Hoisting unit, hoists load to carrying position, and dumps it at delivery point, all under full control from driver's seat. When empty body is returned, another loaded one, perhaps with a different type of material, is there for hauling and dumping . . . an uninterrupted cycle of materials handling using twenty bodies but with only one truck.

In dozens of other plants, various types of bodies are in use handling materials of almost every description from dust to liquid . . . light to heavy up to 7½ tons pay load . . . finished and unfinished products . . . hot materials up to 1500 degrees F . . . and in every operation with one truck serving from 6 to 50 bodies.

The chances are that the advantages of the Dempster-Dumpster can and should be adapted to your plant. Let our engineers cooperate with you. Write for our complete catalog No. 247 now.

Illustrations on this page tell the operating story of the Dempster-Dumpster.

Top right shows a loaded body ready for hoisting. Shown also in this photo is the special twin, self-balancing, spring hinged tops on this particular body.

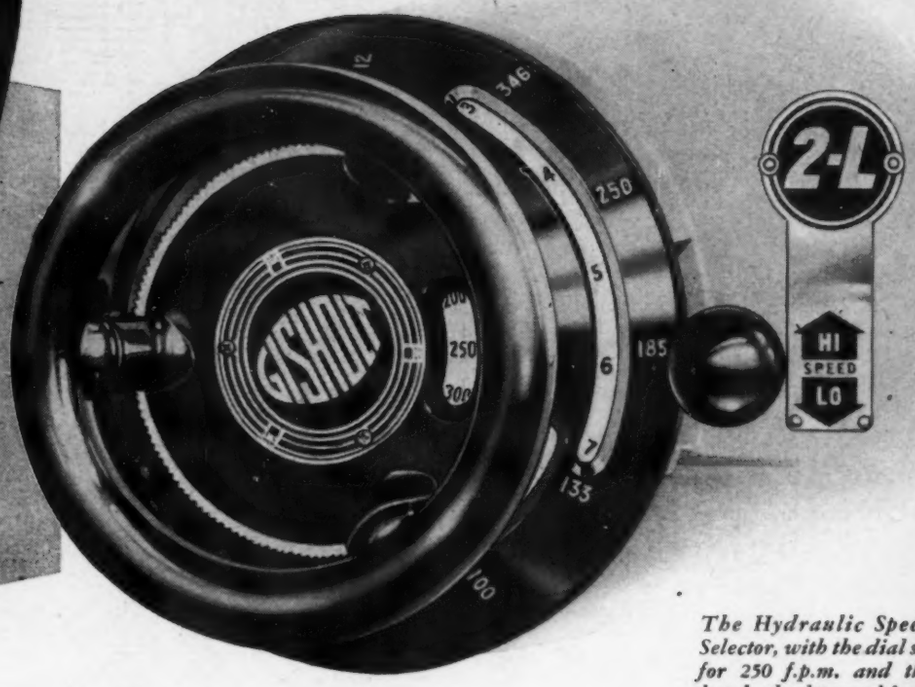
Center Photo shows loaded body in carrying position.

Bottom Photo illustrates instant, or controlled, dumping method of the Dempster-Dumpster bottom dumping type of body.

Types of bodies available are unlimited. Your requirements determine the design. Cooperation of our engineers with those of the customer has corrected hundreds of materials handling problems and at tremendous savings.

DEMPSTER BROTHERS, INC., 247 Higgins, Knoxville 17, Tenn., U.S.A.

YDRAULIC SPEED ELECTOR



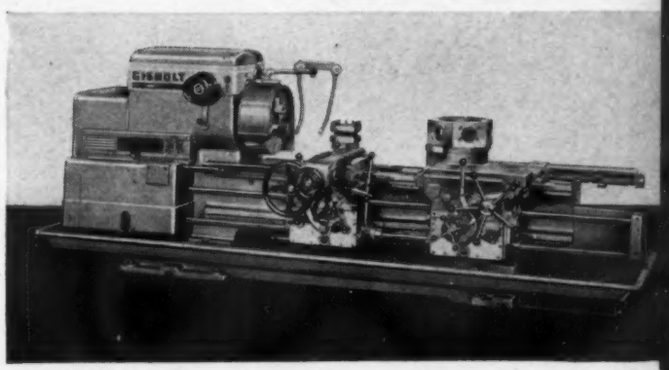
The Hydraulic Speed Selector, with the dial set for 250 f.p.m. and the hand wheel turned for a cut of 5¾-inch diameter.

Now *Standard Equipment* on Gisholt Turret Lathes!

ith a Gisholt you can obtain any one of 12 spindle speeds, stantly, without releasing the main drive clutch—without en stopping the spindle!

With the Hydraulic Speed Selector, you don't waste time d effort between cuts. Merely set the dial for the cutting eed you wish, then turn the hand wheel for the proper ameter. You pre-select the speed and diameter for the xt cut while this one is being made. And when it's time change—just tap the trip lever!

Easy? Of course. But more than that, the Gisholt ydraulic Speed Selector is a big step toward maximum oduction at rock bottom cost.



GISHOLT 2L HIGH PRODUCTION SADDLE TYPE TURRET LATHE—*Product of a half century devoted to the finest class of metal-working equipment, the Gisholt 2L is designed for the maximum speeds and feeds cutting tools will withstand. Incorporated in its rugged design are a number of simple, power operated controls designed to cut time and effort to a minimum. Write for full details.*

THE GISHOLT ROUND TABLE *represents the collective experience of leading specialists in the machining, surface-finishing, and balancing of round and semi-round parts. Bring your problems here.*

ISHOLT MACHINE COMPANY

45 E. Washington Ave. • Madison 3, Wisconsin

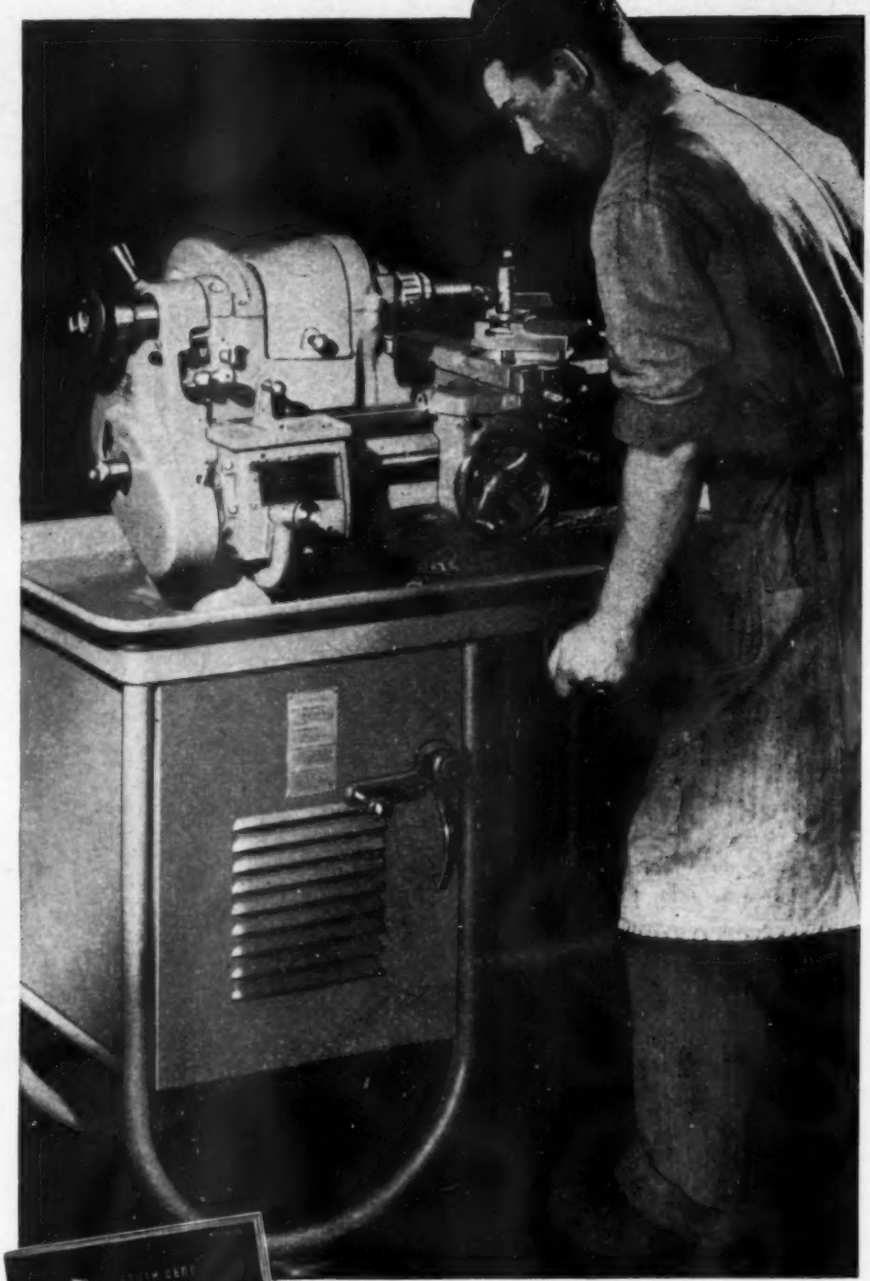
ET LATHES • AUTOMATIC LATHES • BALANCERS • SUPERFINISHERS • SPECIAL MACHINES

For Exacting
CLOSE-TOLERANCE MACHINE WORK

There is no substitute for precision accuracy either in the toolrooms or production plants of present-day industries. The smooth production of precision parts, trouble-free assembly, product quality and prestige, costs, and plant profits depend to a great extent on this one factor. That's why South Bend Precision Lathes, long famed for split-thousandth accuracy, are so widely used in the toolrooms, production shops, engineering and research laboratories, and in the maintenance departments of the nation's leading industries. If you are planning to install new lathe equipment, it will pay you to investigate the many advantages which versatile South Bend Lathes have to offer.

DOUBLE TOOL CROSS SLIDE

This Double Tool Cross Slide is only one item in the complete line of South Bend attachments and accessories which will help to broaden the scope of your lathes. Write for attachment Catalog 77.



ILLUSTRATED ABOVE:

10" x 3' South Bend Quick Change Gear Bench Lathe with Handwheel Collet Attachment. This model made with bed lengths to 4½'. Toolroom models made with beds to 4'.

WRITE FOR CATALOG

Write for Catalog 100-D which shows all types, sizes, and models of South Bend Toolroom, Engine, and Turret Lathes. Made with 9", 10", 13", 14-1/2", and 16" swings. State size lathe in which interested.

SOUTH BEND LATHE WORKS

419 EAST MADISON STREET • • SOUTH BEND 22, INDIANA

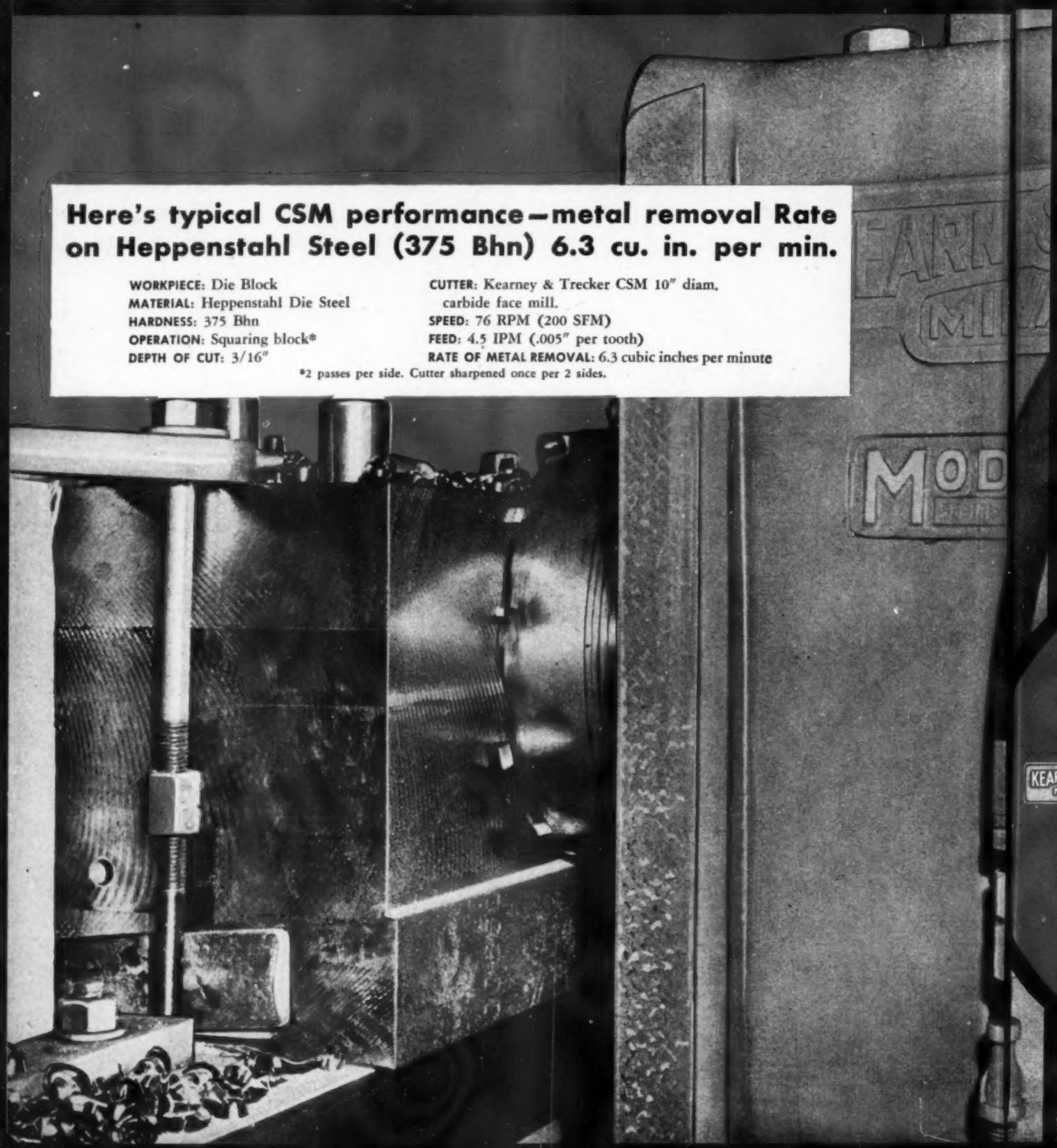
LATHE BUILDERS SINCE 1906

The CLEVELAND TWIST DRILL COMPANY
1242 EAST 49TH STREET
CLEVELAND 14

TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

20 THOMAS ST., NEW YORK 7 • 9 NORTH JEFFERSON ST., CHICAGO 6 • 650 HOWARD ST., SAN FRANCISCO 5
2020 EAST GRAND BLVD., DETROIT 2 • 1902 NORTH FIELD ST., DALLAS 1
E. P. BARRUS, LTD., LONDON W. 3, ENGLAND

Users report astounding new with Super-Powerful Kearney &



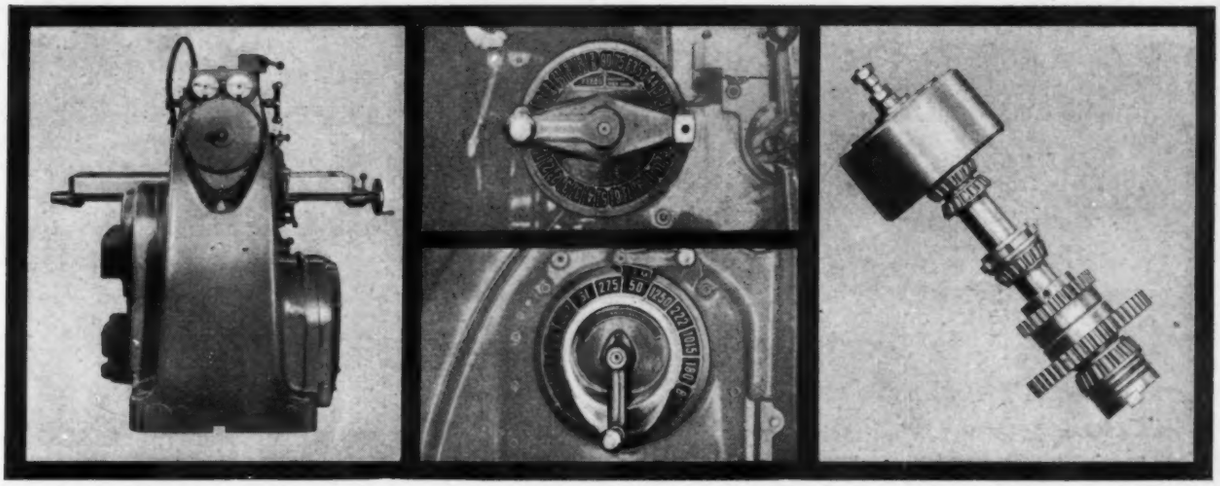
Here's typical CSM performance—metal removal Rate on Heppenstahl Steel (375 Bhn) 6.3 cu. in. per min.

WORKPIECE: Die Block
MATERIAL: Heppenstahl Die Steel
HARDNESS: 375 Bhn
OPERATION: Squaring block*
DEPTH OF CUT: 3/16"
CUTTER: Kearney & Trecker CSM 10" diam, carbide face mill.
SPEED: 76 RPM (200 SFM)
FEED: 4.5 IPM (.005" per tooth)
RATE OF METAL REMOVAL: 6.3 cubic inches per minute

*2 passes per side. Cutter sharpened once per 2 sides.

high rates of metal removal Trecker CSM Milling Machines

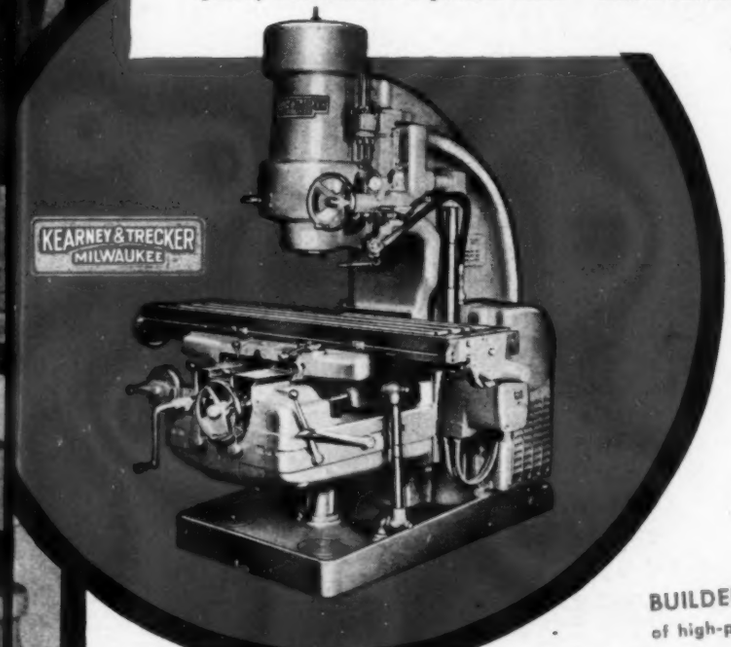
Use carbide cutters to maximum efficiency— high horsepower, extra-husky construction of Kearney & Trecker Milwaukee CSM's make record metal removal rates possible



Look at that column! Pyramid shape, wide base, solid back, box-type ribbing give you maximum rigidity and vibration-free operation. That means high metal removal rates, accuracy, long tool life. Design saves floor space by total enclosure of powerful motor.

Speeds and feeds selected by quick-change dials. Choice of 16 spindle speeds mean right cutter speed for use on almost any material. 32 feeds to table and knee mean right feed per cutter tooth, a key factor in using carbides to best advantage.

CSM's incorporate original vibration-free three-bearing spindle design. Flywheel, now an integral part of spindle, insures constantly smooth flow of power to cutter. Electrical controls for acceleration and deceleration of gear train are part of basic design.



IMPORTANT NOTICE!

Because CSM's are different from any other milling machines — only a check of your production by an experienced Kearney & Trecker engineer, trained in the use of CSM's, can show you the tremendous savings possible. CSM's are made in Plain and Vertical types with 20, 30, and 50 hp. For an on-the-spot personal analysis of how CSM's can increase your production, *wire us collect.* There is no obligation.

KEARNEY & TRECKER CORPORATION

MILWAUKEE 14, WISCONSIN

BUILDERS OF 97 DIFFERENT MODELS AND SIZES

of high-production precision milling machines — power rated for every job.

SMASHING all previous Carbide records!

ANOTHER TYPICAL CASE

Part: Rotors—Electrical Motors
Machine: J & L Universal Turret Lathe
Operation: Turning O. D.
Material: Silicon Steel and die-cast Aluminum laminations
Diameter: 5″
Length: 3″
Depth of cut: .030″-.125″
Feed: .033″
Speed: 440 fpm.
PIECES PER GRIND: 350 (average)
Best previous carbide performance: 120 pieces

Improved

TECO Cemented Carbide

gives

- more pieces between grinds
- more grinds per tool
- less down time
- lower tool cost

DOZENS of plants are now getting from 3 to 10 times their former output per carbide tool, by using Improved TECO Cemented Carbide. If such phenomenal production reports seem "too good to be true"... it's only because you have not tried Improved TECO Cemented Carbide.

Find out for yourself! Tool up any regular carbide job with Improved TECO Cemented Carbide. Run under identical conditions. Then check your pieces per grind —grinds per tool—tool life—tool cost. Check, too, its unusual ability to operate at higher speeds and feeds.

A TECO engineer will gladly demonstrate in your plant. If you prefer making your own run, send details of your job set-up for recommendation. Latest catalog and price list sent upon request.

Improved

TECO

CEMENTED CARBIDE

TUNGSTEN ELECTRIC CORPORATION
568 39th STREET, UNION CITY, N. J.
Branch Office: 403 Western Reserve Bldg., Cleveland 13, Ohio
Representatives: Indianapolis, Ind., Detroit, Mich.

ITS FUTURE HUNG ON A THREAD

As the "horseless carriage" became part of the American scene, it brought a new demand for threading tools. Over 1000 makes of cars were on the road; machine shops mushroomed up over the countryside. But the automobile was only part of it . . . the country was on the threshold of a tremendous new mechanical age. And its future literally hung on a thread, for without fast and accurate threading tools, the miracles of modern precise machinery would have been impossible to attain.

GTD "Greenfield" played a vital role in this industrial revolution, developing threading tools of greater strength, speed and accuracy. Quick to recognize the superiority of GTD "Greenfield" products in those days, metal-working manufacturers have ever since looked to "Greenfield" for high quality in threading tools.

GTD Greenfield 75th YEAR

GTD "Greenfield's" development of improved designs in taps set new standards for cutting internal threads. First operated by hand with tap wrenches, these taps later were used in drill presses, high speed tapping machines and automatic screw machines to give greater speed and accuracy of production.

GREENFIELD TAP and DIE CORPORATION
Greenfield · Massachusetts

The GEOMETRIC TOOL COMPANY
New Haven, Connecticut · In Its Fifty-Fourth Year
A DIVISION OF GREENFIELD TAP and DIE CORPORATION

CLEVELAND

SINGLE POINT Double Action TOGGLE PRESS

- Modern streamline construction.
- Enclosed drive.
- No overhanging gears or brackets.
- Air (or hydraulic) friction clutch.
- Electrical control.
- Economy of floor space.
- Accessibility for loading and unloading.

Cleveland Double Action Toggle Presses are equipped with two slides: an inner, or punch slide; and an outer, or blankholder slide. The latter clamps the material firmly before the die on the inner slide takes effect, and dwells, under pressure, on the material until the inner slide has reached a predetermined point on its upward stroke.

While the Press illustrated has a 28" stroke, 6" adjustment, 500 tons capacity for inner slide, 300 tons capacity for outer slide, this type of Press can be furnished in sizes and capacities to suit particular requirements, and with single connection, as illustrated, or two connections, if desired.

MODERN *Presses*

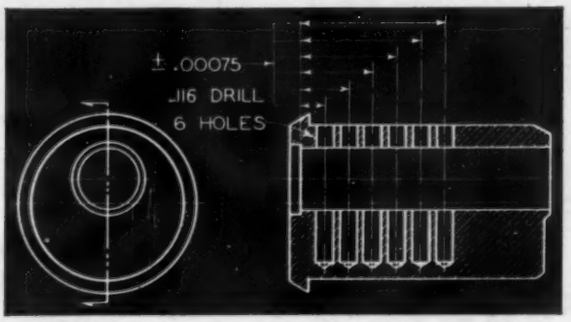
THE CLEVELAND PUNCH & SHEAR WORKS CO.

Cleveland 14, Ohio

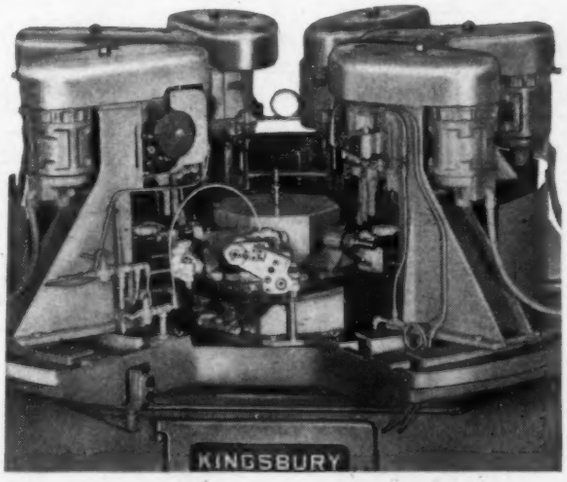
New York · Chicago · Detroit · Philadelphia · Pittsburgh

MULTIPLE DRILLING
FOR
HIGH PRODUCTION

PROBLEM Drill 6 parallel holes in brass lock cylinders, locating each hole within ± .00075.

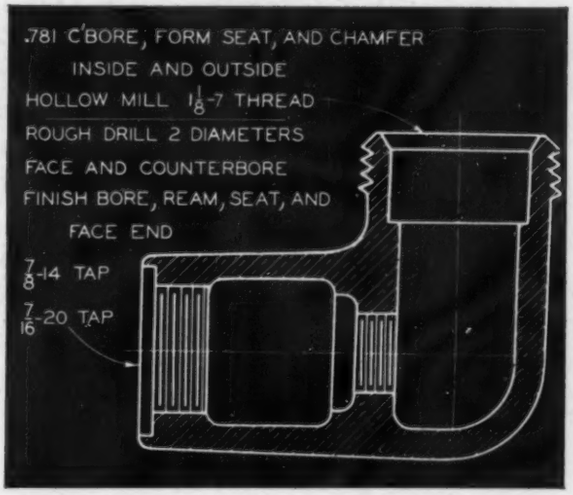


METHOD ± .00075 ACCURACY IN LOCATION for each hole is obtained by drilling every hole without disturbing the work. Furthermore, the tool guide bushings are supported in plates that are piloted onto the fixtures. Each piece is chucked in one of seven identical fixtures, indexed automatically to each drilling unit, and automatically ejected.

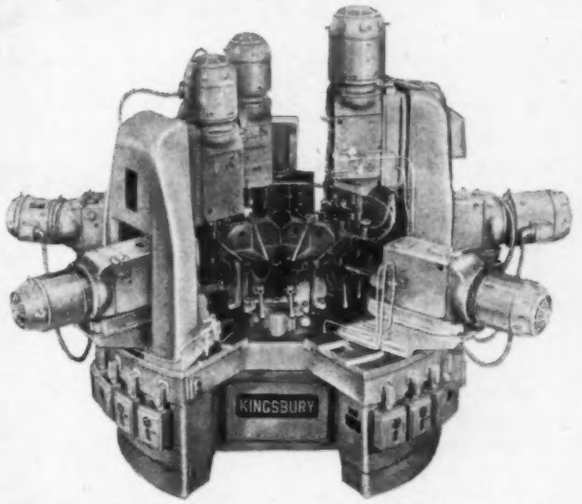


RESULTS 1,000 PIECES PER HOUR GROSS, with one operator, excellent quality control, less handling and less floor space. The use of individual standard units lowers the first cost and permits the utmost efficiency for each operation. These savings quickly pay for the machine.

PROBLEM Machine each corner of 2-way and 4-way brass shower valve units.


.781 C'BORE, FORM SEAT, AND CHAMFER INSIDE AND OUTSIDE
HOLLOW MILL 1⅛-7 THREAD
ROUGH DRILL 2 DIAMETERS
FACE AND COUNTERBORE
FINISH BORE, REAM, SEAT, AND FACE END
⅞-14 TAP
7/16-20 TAP

METHOD WITH ONE CHUCKING PER CORNER all operations are completed on this 9-spindle automatic indexing machine. Each of the seven identical fixtures on the index turret holds the valve units in different positions for machining each corner.

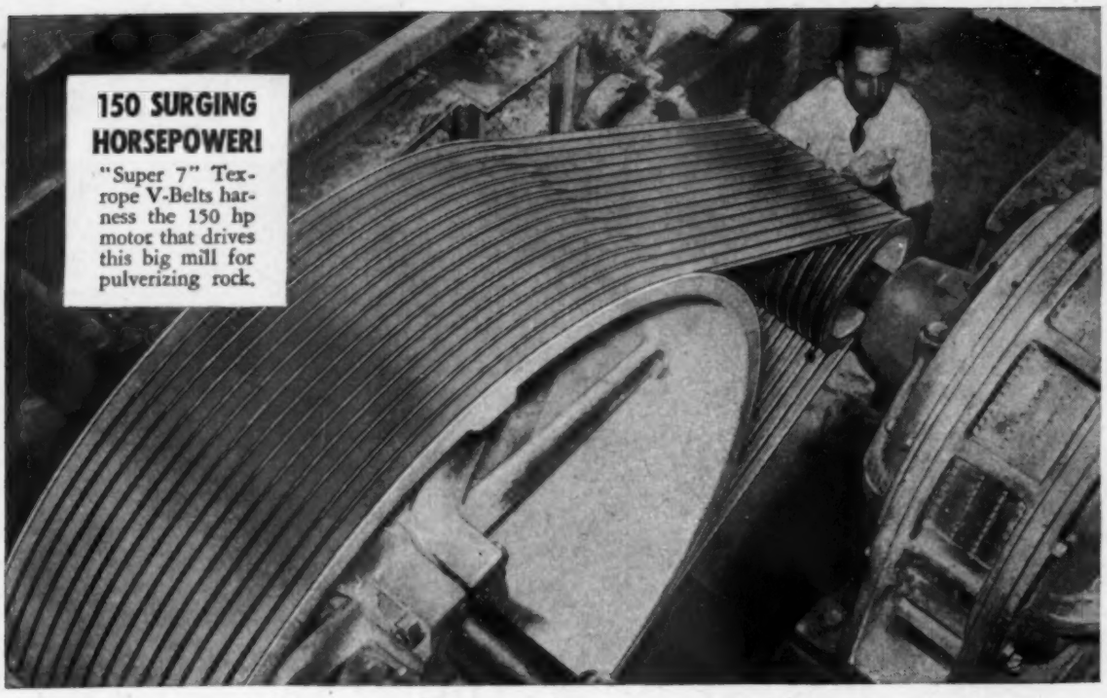


RESULTS 600 CORNERS PER HOUR GROSS with one operator.

If multiple drilling operations up to five hp each are required on your high production work, we can design, build and tool automatic machinery all ready to be installed and started up. Just send us the prints showing the operation and hourly production and ask for proposals.

Kingsbury Machine Tool Corporation, Keene, N. H.

KINGSBURY

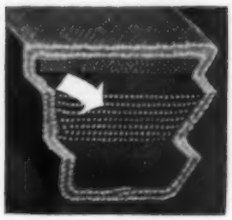


150 SURGING HORSEPOWER!

"Super 7" Texrope V-Belts harness the 150 hp motor that drives this big mill for pulverizing rock.

PULLING POWER

. . . one of the 7 Great Features in "Super 7" Texrope V-Belts!



1. STRONGER CORDS give "Super 7" Texrope V-Belts their great pulling power. These long-fibre, hard-twisted cotton cords have the strength of high-test fish lines. Laid row on row and imbedded in heat resistant rubber compound, they provide a powerful load-carrying element.

2. TOUGHER COVER. Rugged duplex construction protects the carcass of "Super 7" belts from wear and dirt.

3. HEAT RESISTANCE. *All* "Super 7" V-Belts are designed and built to give high resistance to heat.

4. SHOCK ABSORBING. "Super 7" construction combines great strength with the degree of resiliency necessary for long belt life and smooth power transmission.

5. PRECISION CURED in pressure molds to assure accurate section and perfect bonding of cords, cover and cushion.

6. ACCURATELY MATCHED. Every belt weighed, measured and carefully inspected before being sized and packed.

7. ENGINEERING LEADERSHIP. "Super 7" Texrope V-Belts represent 27 years of research and experience — by Allis-Chalmers, originator of the Multiple V-Belt Drive.

• • •

There are FIVE types of "Super 7" Texrope V-Belts, to meet every operating requirement: *Standard — Heat Resisting — Oil Resisting — Oil Proof* — and *Static Resisting*. Call your Allis-Chalmers office or dealer. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

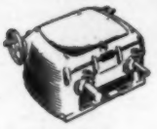
A 2161

TEXROPE .. Greatest Name in V-Belt Drives

"Super 7" V-BELTS
Five Types — Sizes to suit every power transmission job.

Texsteel, Texdrive, "Magic-Grip"
— sheaves in a full range of sizes, grooves.

"Vari-Pitch" SHEAVES
Exact variations in speed, stationery or motion control.



SPEED CHANGERS
Speed variations up to 375% at the turn of a crank.

ENGINEERING
Finest V-Belt engineering talent in the world—at your call.

TEXROPE "Super 7" V-Belts result from the cooperative research of two great companies — Allis-Chalmers and B. F. Goodrich. They are sold only by A-C.

ALLIS·CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

1847 1947
A CENTURY OF SERVICE
to Industry
THAT MADE
America Great

A DIAGONAL GEAR SHAVING MACHINE FOR HIGH PRODUCTION

The new Red Ring Model GCU Diagonal Shaving Machine has been developed especially for mass production. While the principle of Rotary Crossed Axes shaving which has proved itself over the years is retained, an entirely new method of its application provides a number of advantages in production operations. Some of these are:

1. Greater stock removal on each cutting stroke.
2. Reduced time for each cutting cycle.
3. Complete cutting cycle just two passes under cutter.
4. Cutter life materially extended.
5. Cutter cost greatly reduced in many cases.
6. No special cutters required.
7. Better control of lead angle on helicals.
8. Operator fatigue reduced.
9. Oversize gears automatically screened out.
10. Operator's haste cannot jeopardize tooth surfaces.
11. Amount of crown on Elliptiod teeth can be varied.

For full details write for bulletin.

2523

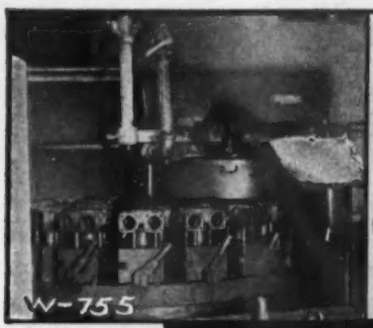
RED RING PRODUCTS

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE • ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

FOR CLOSE LIMITS-*Blanchardize*

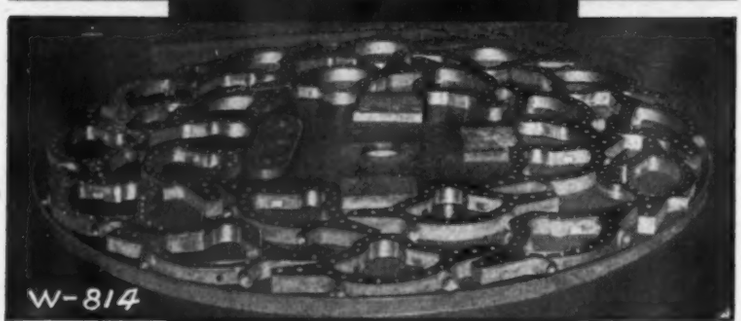

W-755

W-756

The Blanchard No. 18 Surface Grinder is used to rough and finish-grind these oil burner parts, and .012″ of stock is ground off one side to limits of +.0003″ −.0001″. (48 per hour)

W-732

Eighteen of these cast iron ball bearing spacers, with eighteen smaller spacers inside of them are ground to limits of .0002″ after removing .025″ of stock. (144 surfaces per hour)


W-814

This is an excellent example of accurate surface grinding of pump body parts on a No. 18 Blanchard Surface Grinder. The material is high strength forged steel and .004″ of stock is removed from each side to limits of ±.0003″. (80 surfaces per hour)

W-824

These heat-treated steel trunnion bearings are ground on a No. 16-A2 Blanchard Surface Grinder. They are ground to limits of ±.0005″ after removing .005″ to .015″ of stock. (2315 per hour)

Send for your free copy of "Work Done on the Blanchard", third edition. This new book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

BLANCHARD

The **BLANCHARD** MACHINE COMPANY

64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.

THEY SAVE A

Big "BUNDLE OF LETTUCE"

when vegetables are packed under VEEDER-ROOT "COUNTROL"

SHE NUDGES A KNOB AT HER ELBOW when she finishes packing a crate, and that's all she has to do to tally her work as she goes along. Her nudge is acknowledged by a flashing light which indicates that each case has been recorded on the totalizator (shown at lower right on the bank of counters). Slow, old-fashioned check and tally methods are thrown out. Work speeds up. An up-to-the-minute total of production is always visible. And employee relations are improved. That's Veeder-Root *Count*rol.

Standard or special Veeder-Root Counting Devices, built into products as standard original parts, open up limitless possibilities for those products in the way of new uses, new convenience to users, new economies in operation. Find out how *you* can make *your product* count its way to new markets and profits. Just drop a note to the "Counting House," and say when you want an engineer to call.

(Above) Panel of 20 Veeder-Root Small Reset Magnetic Counters. Totalizing counter at lower right. Light in lower center flashes on whenever one of the 20 packers pushes a button.

(At right) Veeder-Root Small Reset Magnetic Counter, Form U. S. for AC only. Height: 5 7/8".

The Counting House of Industry

VEEDER-ROOT INC.

Hartford 2, Connecticut

In Canada: Veeder-Root of Canada, Ltd., 955 St. James St., Montreal 3. *In England:* Veeder-Root Ltd., Dickinson Works, 20 Purley Way, Croydon, Surrey.

CUSTOM MADE FOR PARTICULAR PEOPLE

MANY of America's biggest buyers specify "G-S" when they want Small Gears. And many more smaller but no less *particular people* come to us regularly for gears custom made to the highest standards of uniform accuracy. If your needs are enough for a production run, by all means discuss the job with our capable engineers. Get all the advantages only a quarter century of *intensive* specialization can give. See why we have become recognized as the "World's Largest Exclusive Manufacturers of Fractional Horsepower Gears!"

SEND FOR OUR 4-PAGE BULLETIN

The G-S Bulletin describes many different types and applications of G-S Small Gears. Please ask for a copy on company stationery.

GEAR Specialties

Spurs • Spirals • Helicals • Bevels • Internals • Worm Gearing • Racks • Thread Grinding

2635 WEST MEDILL AVENUE • CHICAGO 47, ILLINOIS

MEMBER OF AGMA

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS

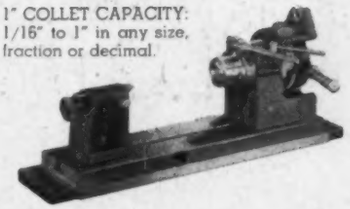
HARDINGE HORIZONTAL - VERTICAL

Collet Index Fixtures with Threaded Nose Spindle are fast in operation and hold work accurately

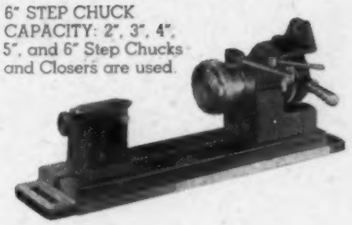
In addition to taking standard collets, this fixture takes step chucks and jaw chucks to cover a wide range of applications. It will eliminate the necessity of your tool room making many specially designed fixtures. Thus, your engineers and tool-makers will have more time for other work.

A preselector arrangement provides the selection of separate indexing of any number divisible into 20 or 24. The collet closer lever has a 100 to 1 leverage for quick opening and closing of collets and step chucks. Write for bulletin.

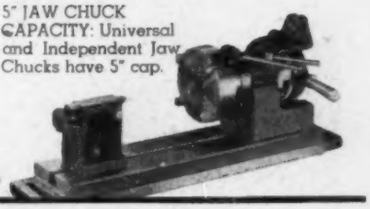
1" COLLET CAPACITY: 1/16" to 1" in any size, fraction or decimal.



6" STEP CHUCK CAPACITY: 2", 3", 4", 5", and 6" Step Chucks and Closers are used.



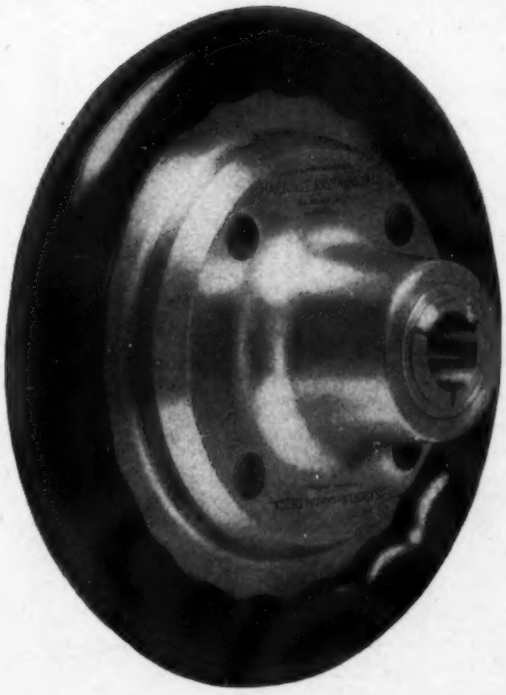
5" JAW CHUCK CAPACITY: Universal and Independent Jaw Chucks have 5" cap.



HARDINGE
ELMIRA, N.Y.

HARDINGE-SJOGREN SPEED COLLET CHUCKS

increase production of your lathes and milling machines

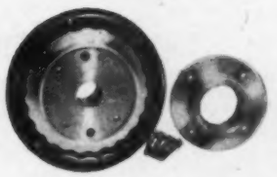


A Hardinge-Sjogren Nose Type Speed Collet Chuck enables you to get full value from your toolroom lathes, engine lathes and milling machines. It gives greater capacity, saves time, increases accuracy and assures better results. An almost effortless turn of the handwheel, one way or the other, automatically opens or closes the collet, releasing or gripping the work as desired. Its grip is adjustable and sure. Production is increased as the operator is always in front of his work. Available in these sizes . . . 1", 1⅜", 1¾", 2¼", or 3½" collet capacity. Write for bulletin.

For CAM-LOCK SPINDLES

For TAPERED KEY-DRIVE SPINDLES

For THREADED NOSE SPINDLES

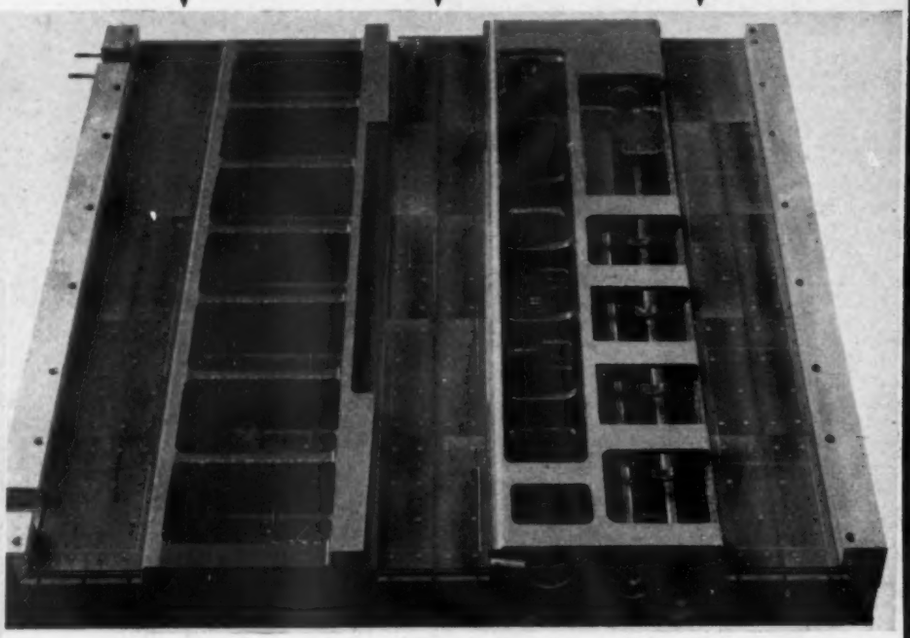


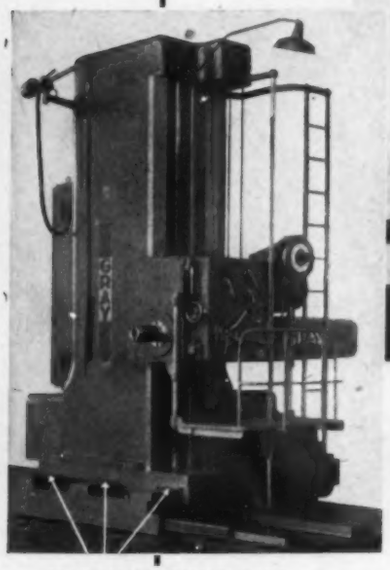
HARDINGE BROTHERS, INC., ELMIRA, N. Y.

GRAY NON-METALLIC WAYS

GRAY NON-METALLIC WAYS

GRAY NON-METALLIC WAYS





GRAY NON-METALLIC WAYS

GRAY NON-METALLIC WAYS*

characterize

GRAY HORIZONTAL BORING, DRILLING and MILLING MACHINES

Cutting and scoring of these vitally important guiding surfaces is thus practically eliminated. The value of this epoch-making development is evident when you consider that a standard column and head weighs 25 tons.

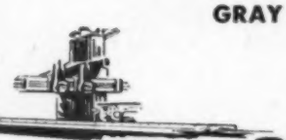
Remember

"A Machine Tool is no better than its ways. There is no adequate substitute for the GRAY NON-METALLIC WAY."

*Protected by Patent #2378343 and Pat. Pending

DOUBLE HOUSING and OPENSIDE PLANERS
•
SWITCH PLANERS
•
DIE BLOCK PLANERS
•
MILLING PLANERS

PLANER TYPE MILLING MACHINES
•
HORIZONTAL BORING MACHINES



The G.A. GRAY Co.

CINCINNATI 7, OHIO, U. S. A.

Sold in Canada by Upton, Bradeen and James Ltd. ● Sold in Latin America by Machine Affiliates.

Van Keuren

MICROGAGES

Set MTT MICROGAGES. 35 Gages giving 140,000 combinations $95.00

Set MT MICROGAGES. Over 5,000 combinations in thousandths $35.00

A FOUNDATION FOR ACCURACY FOR 25 YEARS

VAN KEUREN MICROGAGES are high precision working gages, designed for use on all ordinary work and economically practical for use in production because of their low cost. Their great value in general shop use lies in the fact that they enable the workman to achieve the accuracy required by the inspector.

MICROGAGES are of first quality oil hardening alloy tool steel, exceptionally hard, carefully seasoned, with accurately flat and parallel mirror-like surfaces. They combine readily by wringing together and because of their size (11/16" dia.) are ideally suited for checking heights; widths, slots, machine set-ups, gage setting and many other uses. They are made round in order to assure the best distribution of wearing surface, which is about equal to that of rectangular gage blocks.

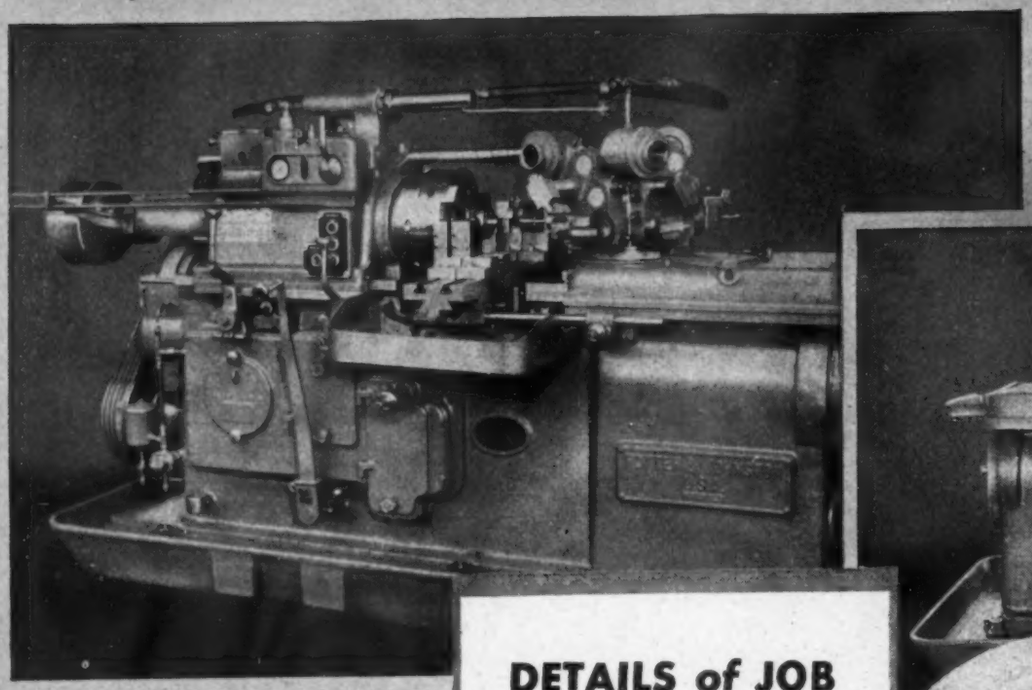
MICROGAGES up to 1" in length have a tolerance of plus .000015" minus .000010". They average 5 millionths of an inch oversize which provides the WEAR ALLOWANCE feature of these gages.
VAN KEUREN MICROGAGES are available in sets especially designed for general shop use, for gage setting and for toolmakers and machinists. Individual MICROGAGES in standard sizes are also available in a size up to 6" in length.

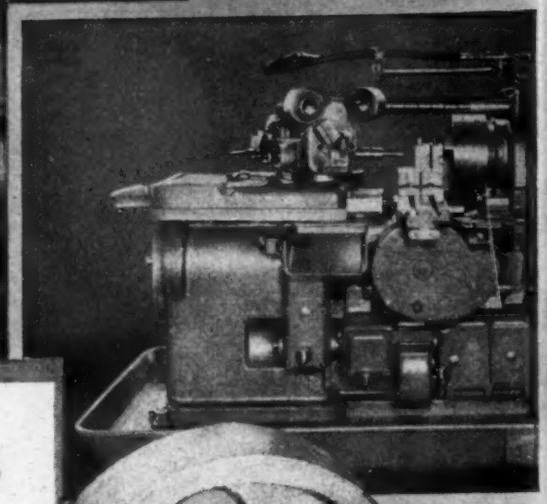
Toolmakers MICROGAGE SET M64. Gives 121 combinations. $15.00

Complete details on MICROGAGES and the full line of Van Keuren Precision Measuring Tools are contained in Catalog No. 33, a 168-page manual for toolmakers, machinists and inspectors—sent promptly on request.

Van Keuren

28th YEAR





This P & J 4-D AUTOMATIC

DETAILS of JOB

Procedure:

Grip in 3 holes in web with 3 chuck jaws.

Machine as follows:

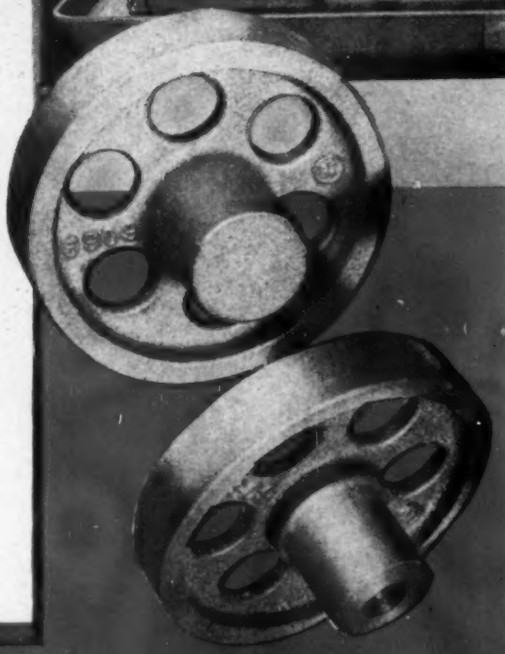
1st T.F.—Drill hole.

2nd T.F.—Rough turn O.D.; face both sides at rim; face one end of hub; chamfer hole.

3rd T.F.—Bore hole; turn O.D., face rim.

4th T.F.—Ream hole.

5th T.F.—Size turn O.D.



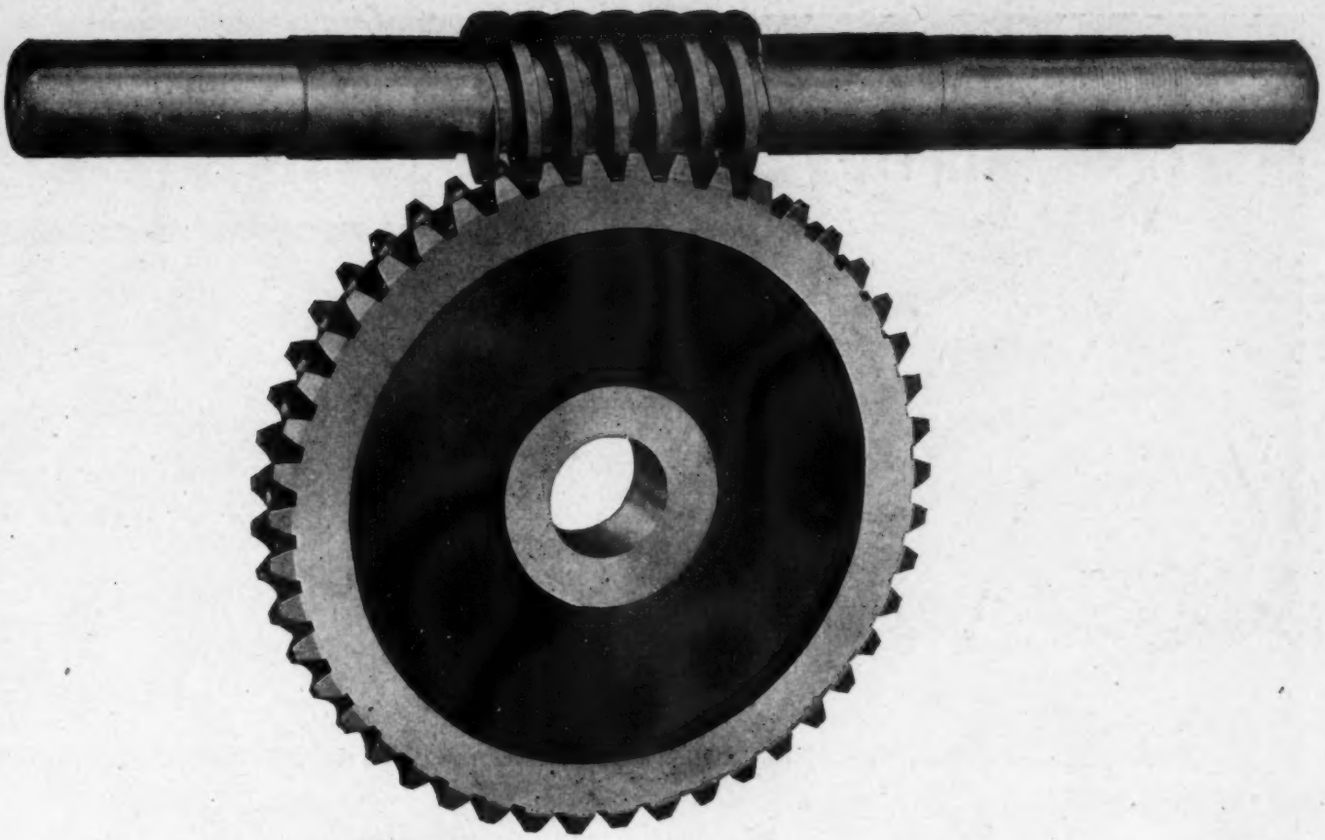
. . . like all P & J Machines . . . is easily tooled for fast, accurate production . . .

Small or medium size parts, as represented by the cast iron crank gear shown here, can be duplicated efficiently and at low cost on the P & J 4 D Automatic. The inherent versatility on tooling which characterizes all P & J Automatics makes it possible to provide setups which assure the maximum in productivity. The sturdiness, stamina and power of all P & J machines are such as to permit fast feeds and speeds and the utilization of carbide tools to greatest advantage.

In cases where lot size & production demands warrant a double spindle setup, P & J is prepared to meet requirements with two spindle machines in three different sizes. Call on P & J for assistance on any problem involving the production of duplicate parts.

POTTER & JOHNSTON MACHINE CO.

Pawtucket, Rhode Island



Here are just a few of the many products on which ADAMS GEARS are being used . . . .

Machine Tools • Aircraft

Motor Trucks • Diesel Engines

Farm Machinery

Road Machinery • Tractors

Printing Machinery

Speed Reducers

You'll get smoother, more efficient operation for your product with *Adams Gears!*

"Tailor-made" gears designed especially for the job provide the opportunity to improve the performance standards of your product. Built for the product, they often simplify assembly and reduce production costs, too. Here at Adams we are specialists in making gears that meet your specifications exactly. Care and control exercised at every stage in their manufacture assure smooth, efficient power transmission. Write for further details.

THE ADAMS COMPANY, 1942 Bridge St., Dubuque, Iowa

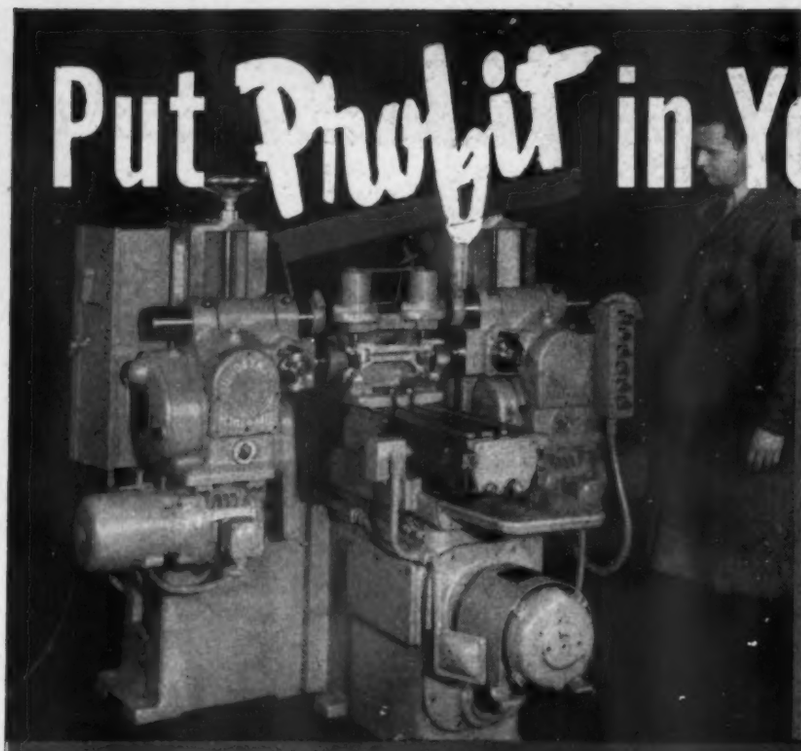
the ADAMS compa

Dubuque, Iowa, U. S. A.

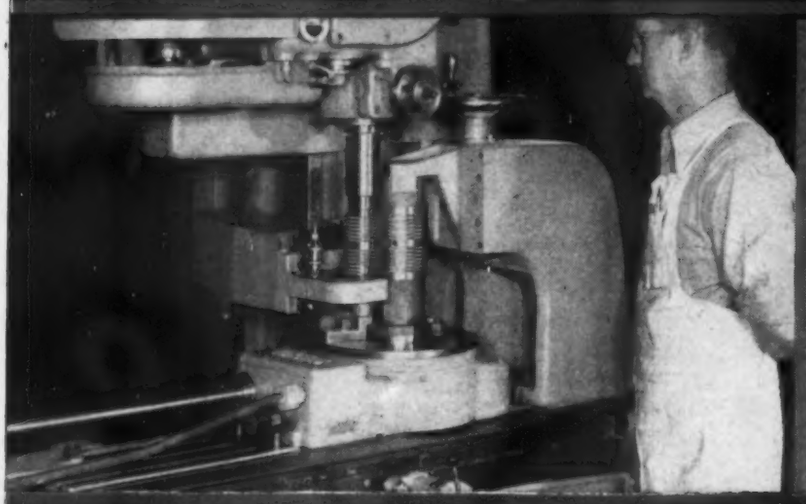
GEARS

FINE GEARS MADE TO YOUR SPECIFICATIONS . . . . . ESTABLISHED 1883

Put Profit in Your Milling



1 Standard Rigidmils with Fixtures and Tooling to Suit Your Work



2 Standard Rigidmils with Special Heads and Tooling

3 Entirely Special Machines

SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

RIGIDMILS | FLUID-SCREW RIGIDMILS | AUTOMATIC LATHES | HYDRAULIC EQUIPMENT

Methods with . . SUNDSTRAND "ENGINEERED PRODUCTION"

1 Here's a *standard* Sundstrand No. 0 Duplex Hydraulic Rigidmil milling both ends of an aluminum die casting simultaneously. Both surfaces are thereby held in definite relation to each other because there is no relocating of the part between cuts. The part is irregularly shaped and difficult to hold. Consequently, power clamping, adjustable over a wide range to obtain the exact clamping pressure required, was provided. As the machine was hydraulically actuated, it was relatively simple to add an auxiliary clamping pump to the circuit. Production is 70 pieces per hour.

2 This *standard* Sundstrand Rigidmil with a special vertical spindle head mills 6 oil grooves in 2500 piston rings per hour. The special spindle carries a cutter arbor which holds 14 saws. A standard Sundstrand Automatic Index Base is mounted on the regular machine table. This base carries a fixture provided with a removable arbor holding 28 piston rings. The milling cycle is completely automatic.

3 This special two station Sundstrand Rigidmil is designed to rough and finish mill port faces on two different manifold parts. Machine has two vertical heads, one with eight spindles and the other with ten spindles. One head is used to rough and finish mill the four port faces of the intake manifold while the other rough and finish mills the port faces of the exhaust manifold. Machine has built-in chip conveyor which automatically ejects chips.

Profitable milling production can be obtained only by lowering unit production costs . . . obtaining the most economical solution to your milling problem and the most productive equipment in relation to your production requirements

Basically, there are two approaches to solving these problems: (1) obtaining standard machines, then trying to process parts over these machines as economically as possible, (2) designing the most profitable processing method, then obtaining machines to suit this method—standard or semi-standard machines, if possible, or entirely special machines, if necessary.

This latter method is Sundstrand "Engineered Production" . . . a most practical approach to economical milling. Here's how it has been applied in three different plants on three different milling problems.

More *free* Milling Production Facts

More proof of the successful application of Sundstrand "Engineered" milling production is contained in this book. Over 60 problem solutions complete with tooling diagrams are included. Write for your copy today. Ask for bulletin No. 159.

SUNDSTRAND MACHINE TOOL COMPANY

2533 Eleventh St. • Rockford, Ill., U.S.A.

DRILLING AND CENTERING MACHINES | SPECIAL MILLING AND TURNING MACHINES

MAKE 1947 PRODUCTS ON 1947 PRESSES

Speed, power, streamlining, are the features that distinguish modern automobiles . . . and modern presses.

Put the same efficiency into your production line that is engineered into your products . . . Designed for maximum utility, Danly presses have the mechanical accuracy and rugged construction that make for faster runs, more accurate stampings, longer die life, less downtime, and *greater production.* Enclosed construction saves floor space, lessens safety hazards—especially in rows or batteries.

Bring your production equipment in step with the products you manufacture. *Make 1947 Products on 1947 Presses.*

STEEL UNIT FRAMES

Danly Open Back Inclinable and Horning presses have unit frames of rugged one-piece all-steel construction. The frames, massive for presses of this type and size, lend great rigidity and resistance to deflection to these presses. Gears and driving members completely enclosed within the frame run in a spray of filtered oil.

Unusually long gibbing and two slide connections make for even pressure along the full length of the stroke—insure accurate alignment on large or progressive dies—prevent eventual loosening up or slide play due to uneven loads.

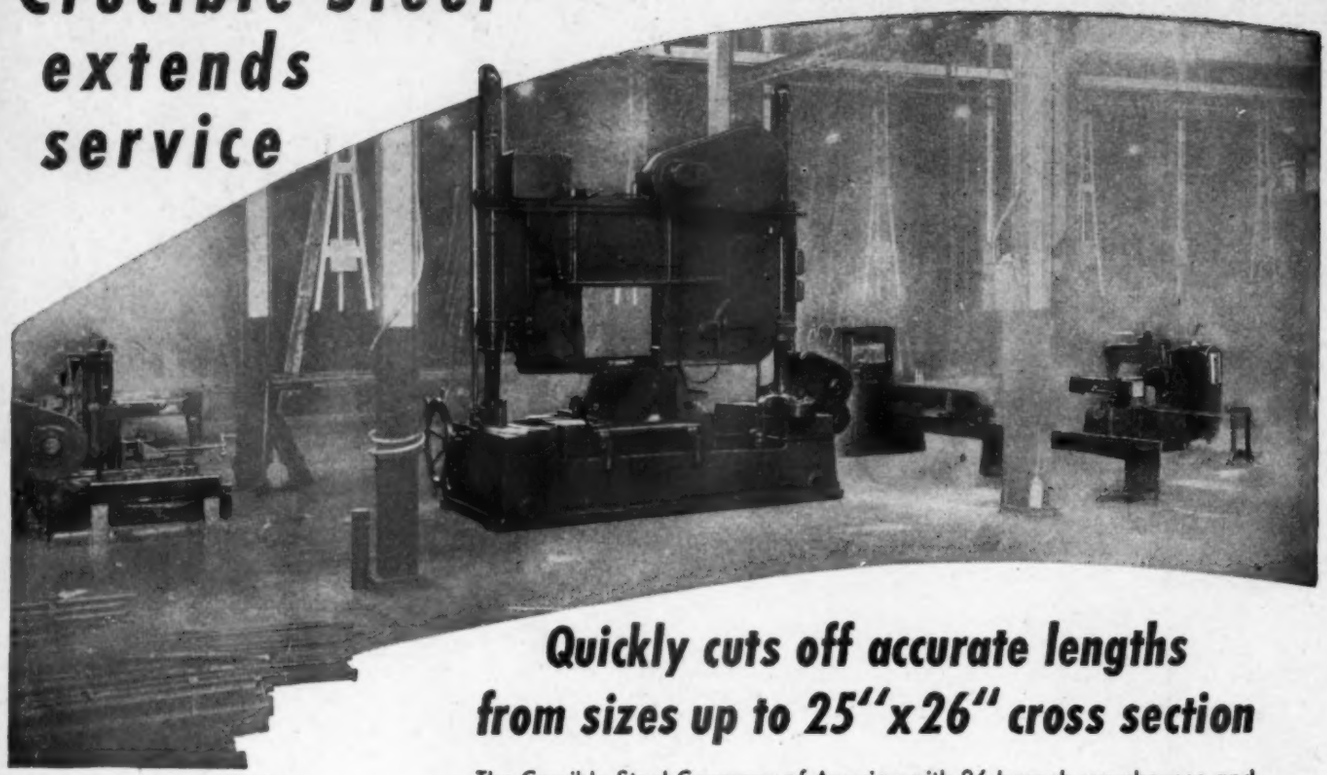
Danly O.B.I. and Horning presses range from 50 to 200 tons pressure in both single and two-point models.

DANLY
The Press for Modern Production

These double geared presses are typical of Danly's complete line of one, two and four point straight-side presses. Pressures range from 100 tons up. Special sizes and types engineered to specifications.

DANLY MACHINE SPECIALTIES, INC.
2100 South 52nd Avenue
Chicago 50, Illinois

Crucible Steel extends service



Quickly cuts off accurate lengths from sizes up to 25"x26" cross section

The Crucible Steel Company of America with 26 branch warehouses and sales offices, has built a reputation for anticipating customers' needs, not only in high grade and special steels, but in service requirements as well. They were among the first to equip several of their warehouses with modern high speed MARVEL Saws (No. 6 and 9A series) in order to give fast service on either single lengths or large quantities of identical pieces, accurately cut from bars up to 10" x 10" cross section. Now in anticipation of new demands for larger sizes, they are the first steel company to install a No. 24 MARVEL Hydraulic Hack Saw in order to give fast service on orders for steels of any type *in sizes up to* 25" x 26" cross section.

This giant hack saw, which almost qualified as a "secret weapon" because it contributed so materially to our production capacity in building naval ordnance, applies an entirely new principle of reciprocation that has made "hacksawing" of large work practical for the first time.

Whatever your metal sawing problems, there is a MARVEL Saw exactly suited to your needs. A MARVEL field engineer will be glad to go over your metal sawing problems with you.

No. 24 MARVEL giant Hydraulic Hack Saw. (capacity 24" x 24"). Employs new "Roll Stroke" sawing action and trouble-free low pressure hydraulic control.

No. 9A MARVEL Production Saw (capacity 10" x 10"). Automatically feeds, measures and cuts-off identical lengths from single or nested bars with no more operator attention than an automatic screw machine.

No. 6 MARVEL Saw (capacity 6" x 6"). A high-speed, heavy-duty, all-ball-bearing saw—operates up to 149 strokes per minute, cuts thru 64% of each stroke, returns in 36%.

ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

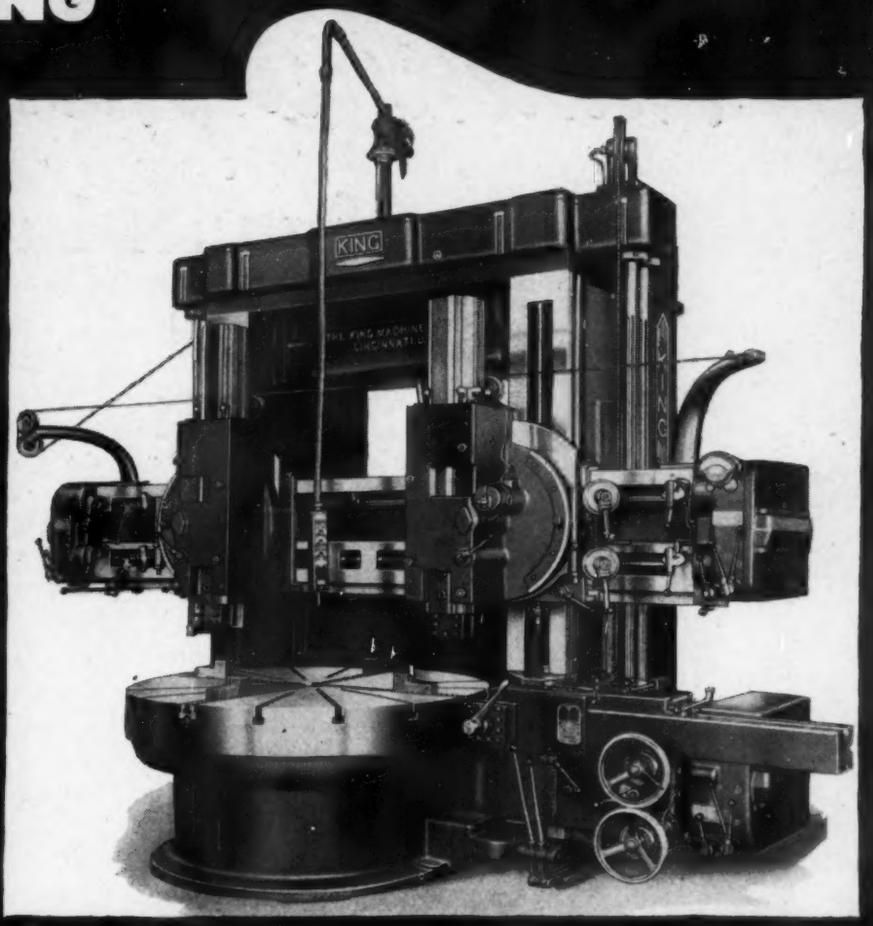
5700 BLOOMINGDALE AVENUE, CHICAGO 39, U.S.A.

No. 1, No. 2 Series Capacity: 4"x4" Capacity: 6"x6" | No. 4B Series Capacity: 6"x6" | No. 6 Series Capacity: 6"x6" | No. 9A Series Capacity: 10"x10" | No. 8 Series Capacity: 18"x18" | No. 18 Series Capacity: 18"x18" | No. 24 Series Capacity: 24"x24"

MARVEL SAWS

New Series 72" KING

VERTICAL BORING AND TURNING MACHINE



Look for these features on your next Vertical Boring and Turning Machine

A SUBSTANTIALLY HEAVIER MACHINE

★

NEW, ACCURATE SWIVEL RAM HEADS

★

INCREASED RANGE OF SPEED

★

GREATER RIGIDITY

★

SIMPLIFIED CONTROL

★

IMPROVED APPEARANCE

● These are a few of the many reasons why the new series King Vertical Boring and Turning Machines will give you added production at lower costs.

They're easy to operate. Every single control lever is located at front of machine—completely accessible.

They're accurate and powerful. The increase in weight plus new massive, rectangular type ram heads give you the rigidity necessary to successful use of carbide tools.

The new King Vertical Boring and Turning Machines are available in 10 sizes—Single Column Type—30", 36", 42"; Double Column Type—52", 62", 72", 84", 100", 120" and 144".

Write for complete details.

THE KING MACHINE TOOL COMPANY

CINCINNATI 29, OHIO

Builders of Vertical Boring and Turning Machines Exclusively

Profit-stealer:

Hidden depreciation

of machine tools

SOME MACHINE TOOLS in metal turning industries show little wear and tear depreciation—can still maintain the same volume of output as the day they were installed. Yet many of these machines have undergone hidden depreciation in value because of their *inadequacy* as profitable producers.

And they will continue to decrease in productive worth—as rising material, labor and overhead expenses continue to raise unit costs and cut profits—unless ways are found to boost their efficiency.

Warner & Swasey field engineers have successfully helped many manufacturers increase the productive value of their machine tools, either through new accessories for faster, easier operation, or by suggesting new tooling setups or specially devised tooling for increased production.

Frequent appraisal of machine tool productivity should be made to prevent complete obsolescence of any machine tool. The Warner & Swasey representative can quickly spot replacement needs—can suggest the *proper* machine tool for your particular operation.

Let him show *you* how

You can machine it better, faster, for less... with a Warner & Swasey

WARNER & SWASEY
Machine Tools
Cleveland

TURRET LATHES, MULTIPLE SPINDLE AUTOMATICS, PRECISION TAPPING AND THREADING MACHINES

Look to MODERN for accurate, fast, economical thread cutting

Hardened and ground throughout

Wider threading range

Made with least number of parts

Cut close-to-shoulder threads without special chasers

Easily adjusted for thread size

Greater flexibility

Quick and easy chaser change

MODERN

STATIONARY TYPE SELF-OPENING

DIE HEADS

Modern Precision Tools Include . . . . .

- STATIONARY SELF-OPENING DIE HEADS
- ROTARY SELF-OPENING DIE HEADS
- STATIONARY COLLAPSIBLE TAPS
- ROTARY COLLAPSIBLE TAPS
- MODERN-MAGIC CHUCKS AND COLLETS
- SELF-OPENING STUD SETTERS
- INSERTED BLADE FACE MILLING CUTTERS
- SOLID ADJUSTABLE DIE HEADS
- ADJUSTABLE HOLLOW MILLING TOOLS
- UNIVERSAL CHASER GRINDING FIXTURES

Modern Self-Opening Die Heads thread diameters from ⅛" to 7" in standard heads, and up to 14" in special heads . . . accurately, fast, and economically. They are adapted to practically every thread cutting operation within their capacity. Designed for use in hand screw machines, turret lathes, and other machines where the die heads are used in a stationary position.

For complete information, write for Bulletin No. M-123

MODERN TOOL WORKS

DIVISION OF

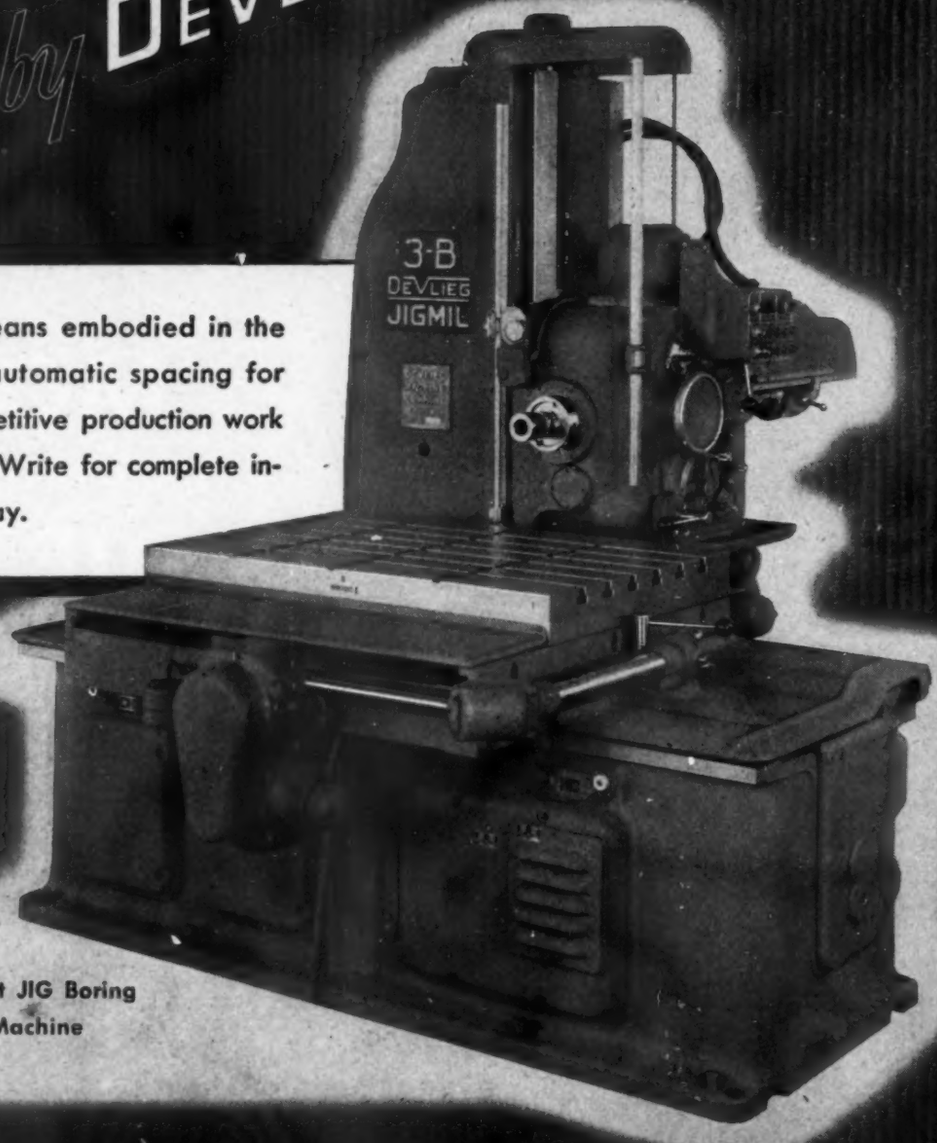
CONSOLIDATED MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

Announcing

DUPLITROL *by* DEVLIEG

● A new means embodied in the JIGMIL for automatic spacing for duplicate repetitive production work without JIGS. Write for complete information today.



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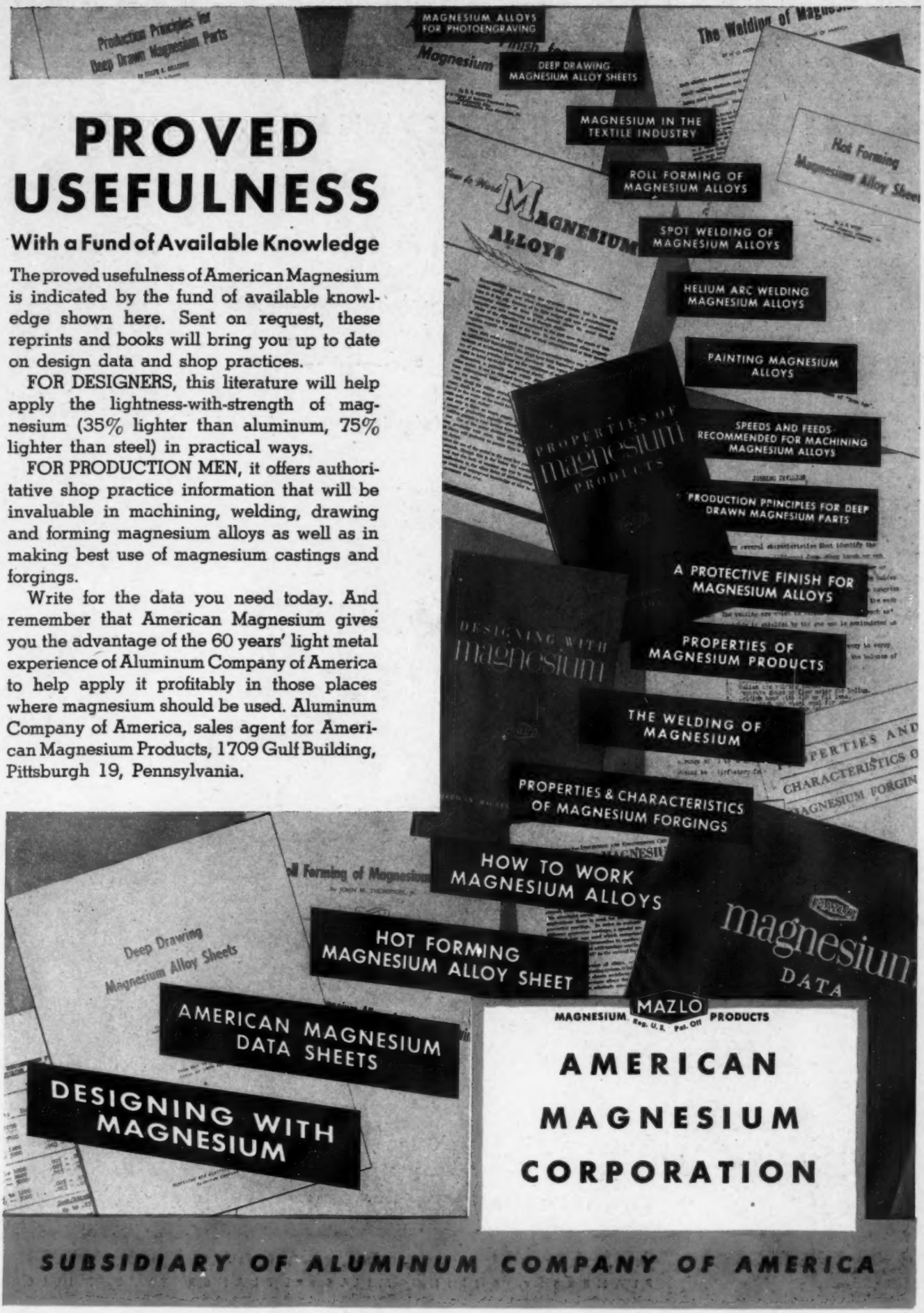
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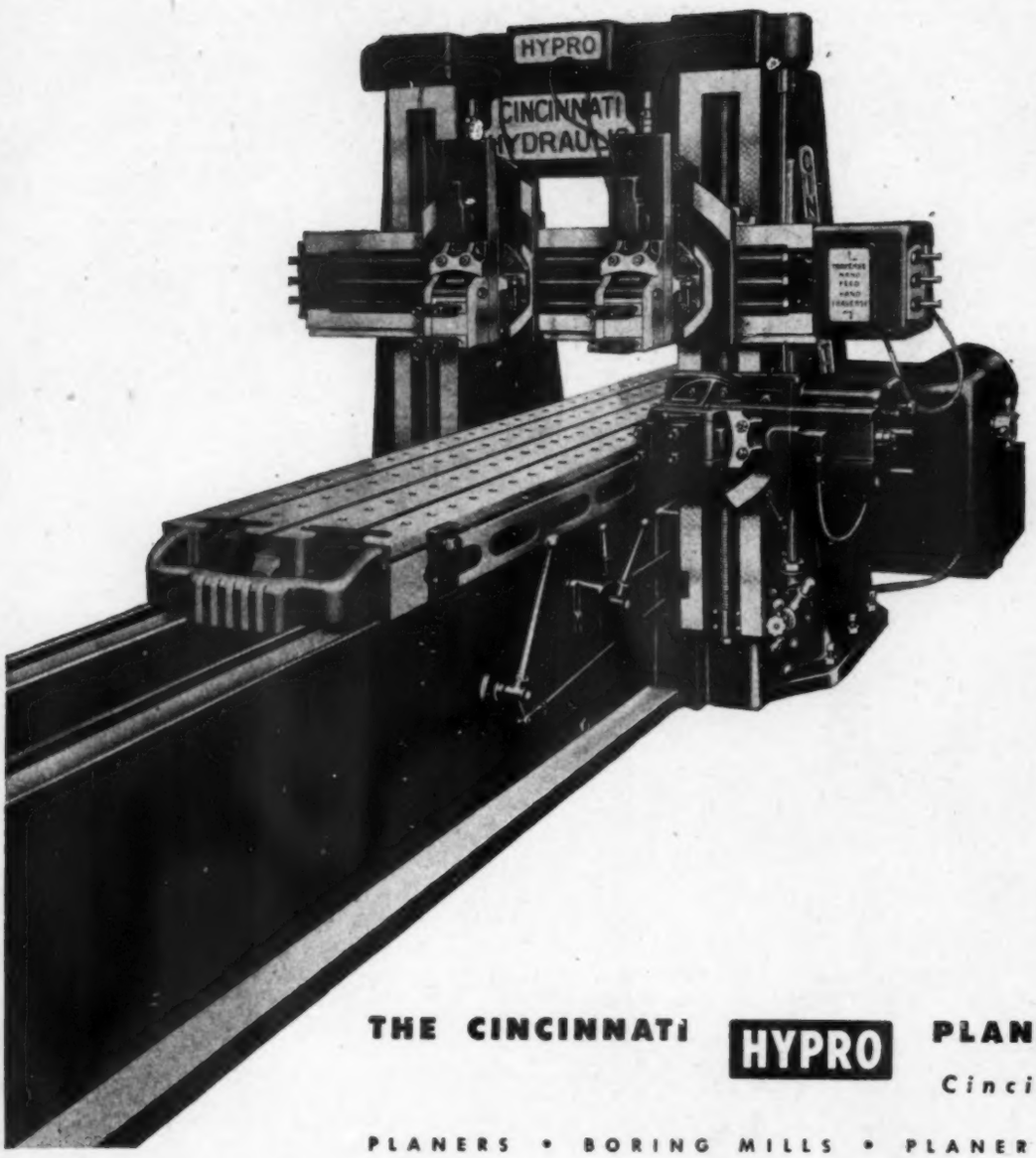

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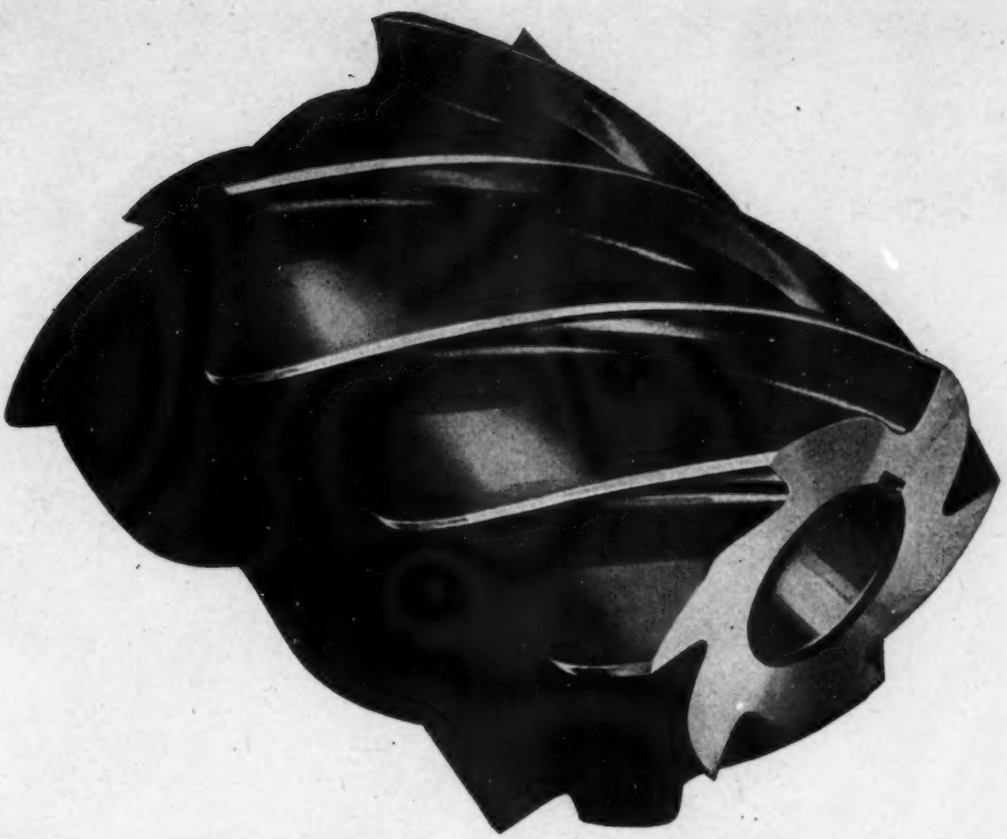

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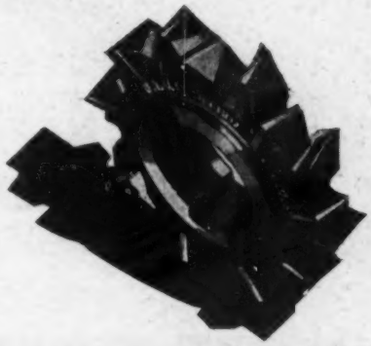

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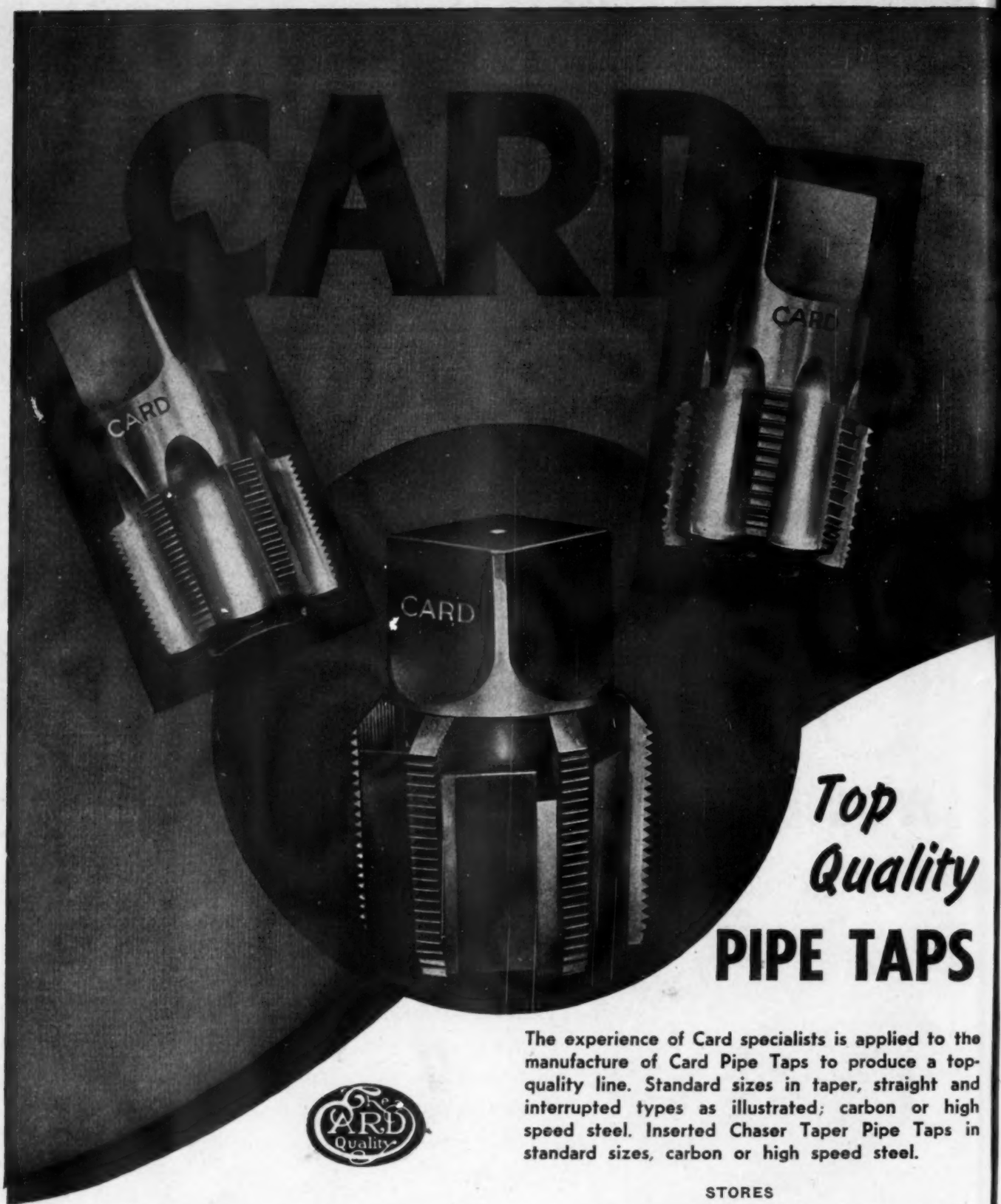

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S FEATURES

THE *New* RIVETT 918-S PRECISION CABINET LATHE

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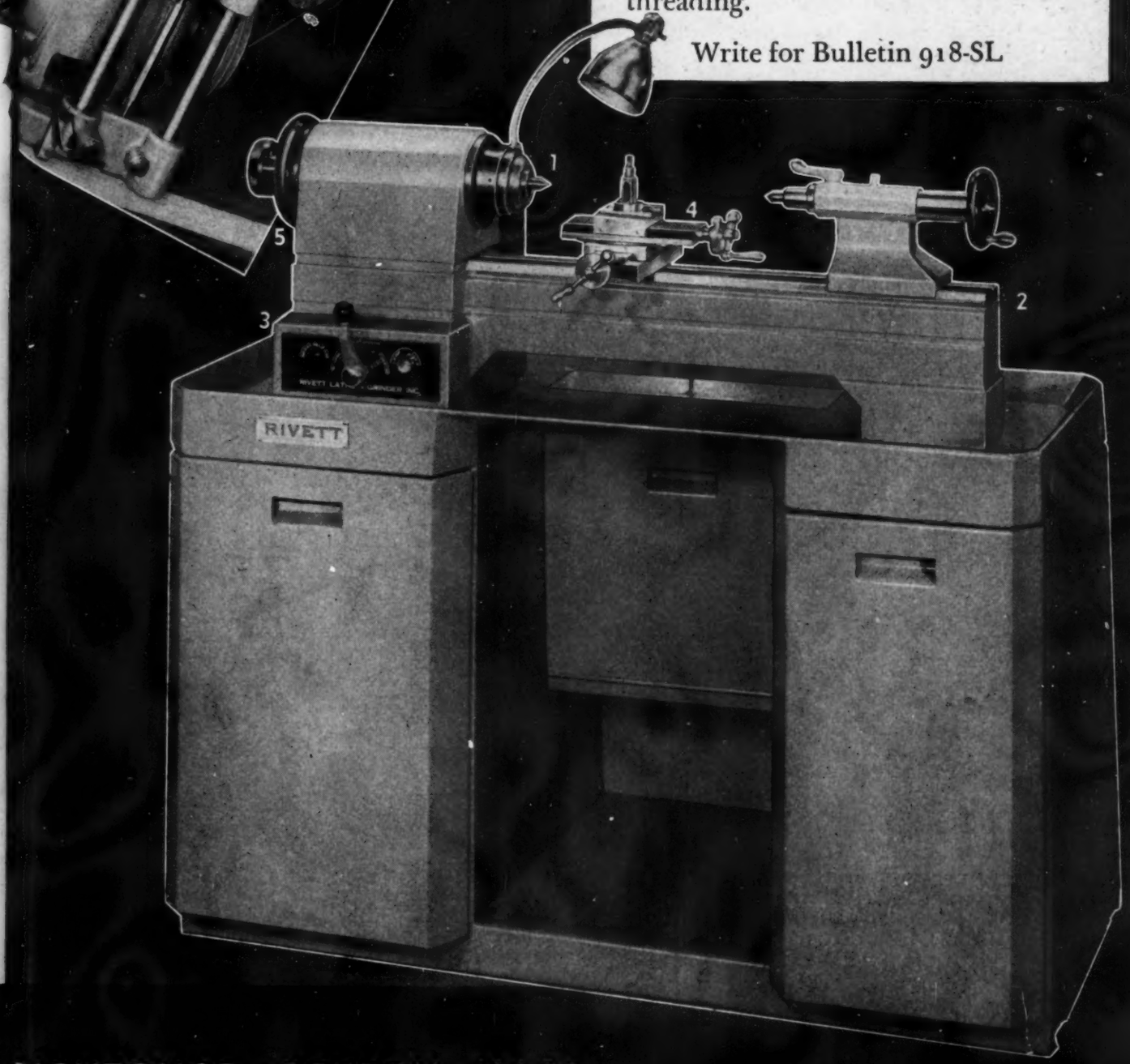

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give the lowest possible tool cost

The more operations you tool with ARMSTRONG TOOL HOLDERS, the greater your savings and profits. These permanent multi-purpose tools are low in initial cost. They give years of continuous service, reducing the direct tool cost per job to a matter of cents. Using small cutters or bits quickly ground from stock shapes they "Save: All Forging, 70% Grinding and 90% High Speed."

But greater still than these substantial direct savings are the indirect savings these tools effect. They reduce "tooling-up" to a matter of minutes—end costly delays and keep men and machines producing. Strong and efficient, they permit higher speeds and heavy feeds—machine more pieces per machine hour, machine more accurately, reducing losses through rejects or spoilage.

Use ARMSTRONG TOOL HOLDERS for every operation on lathes, planers, slotters and shapers, on turret lathes and screw machines, to cut costs and increase profits.

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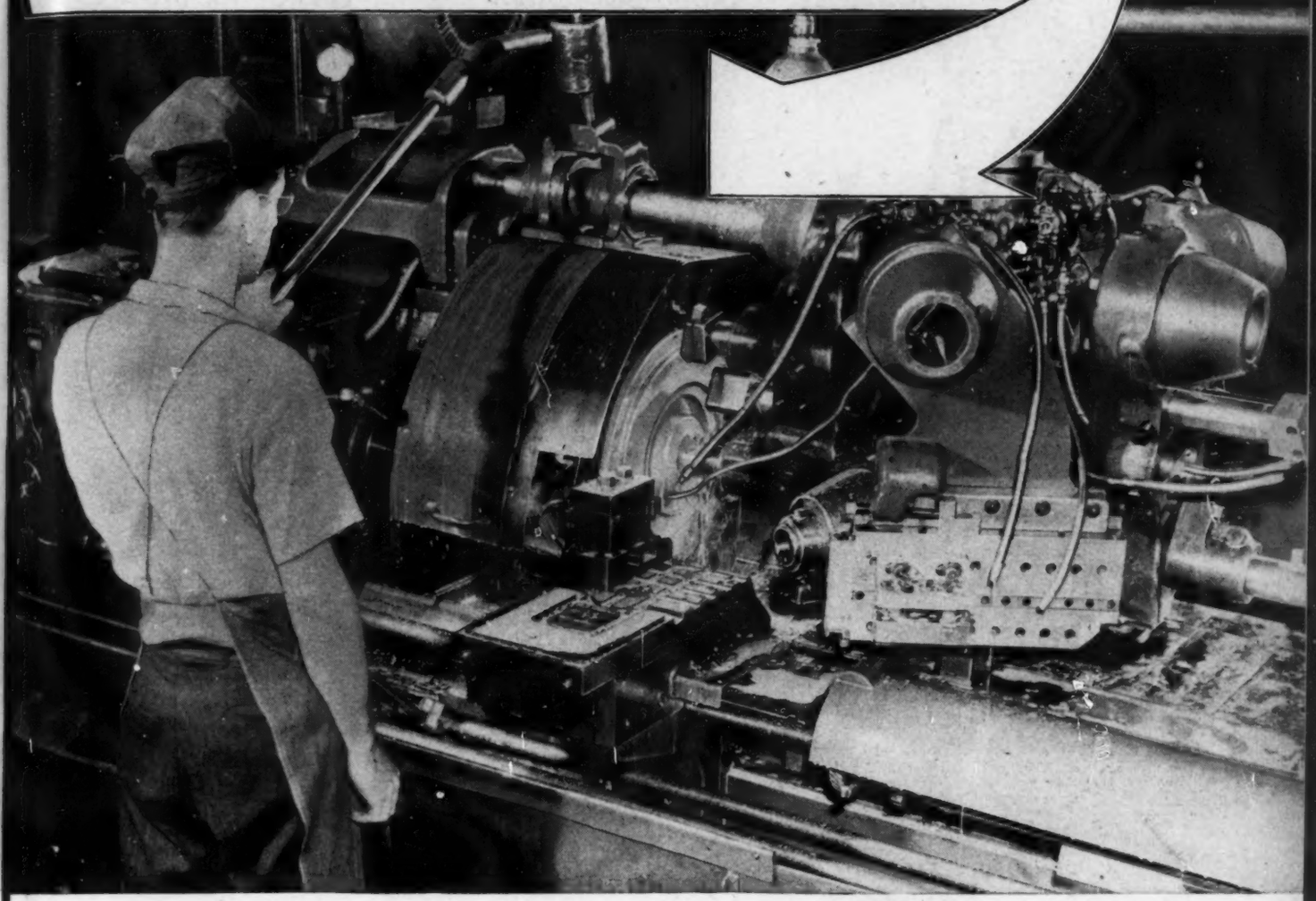
Removing 27 lbs. of metal—*FASTER* with the *FASTERMATIC*



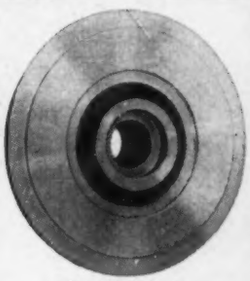
• Here's the kind of operation that makes this automatic turret lathe ideal to put heavy chucking work on a swift production basis.

With multiple tooling on the cross slides and turret faces, this Fastermatic removes 27 pounds of metal from a 95-pound steel casting in 17 minutes including turret indexing time. During this completely automatic cycle, close tolerances are obtained in boring and outside turning—and a total of 15 cuts are taken.

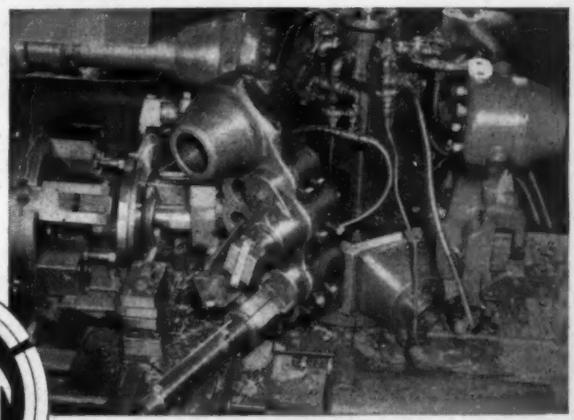
It's another example of the way that power and multiple tooling can be applied on the Fastermatic to handle a larger number of operations in one chucking. With a completely automatic machining cycle, quick indexing, fast traverse, and automatic feed changes, the Fastermatic cuts idle time to a minimum—cuts costs to the bone.

Ask for facts on how the Fastermatic can cut costs on your specific work.

Rough Casting



Semi-finished



Close-up of Fastermatic tooling for machining 95 lb. transmission carrier. The Fastermatic has the power and rigidity for heavy chucking work and the permanent accuracy for precision in all work.

GISHOLT MACHINE COMPANY

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Controls concentrated on the heads of Cincinnati Bickford Super Service Radial Drills are exceedingly "handy" and are easy to manipulate.

The design of the head gives the operator a clear, unobstructed view of the work while standing in a comfortable, normal position—no stopping or twisting for a better view.

These powerful, accurate machines are easy on the hand and eye.

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RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

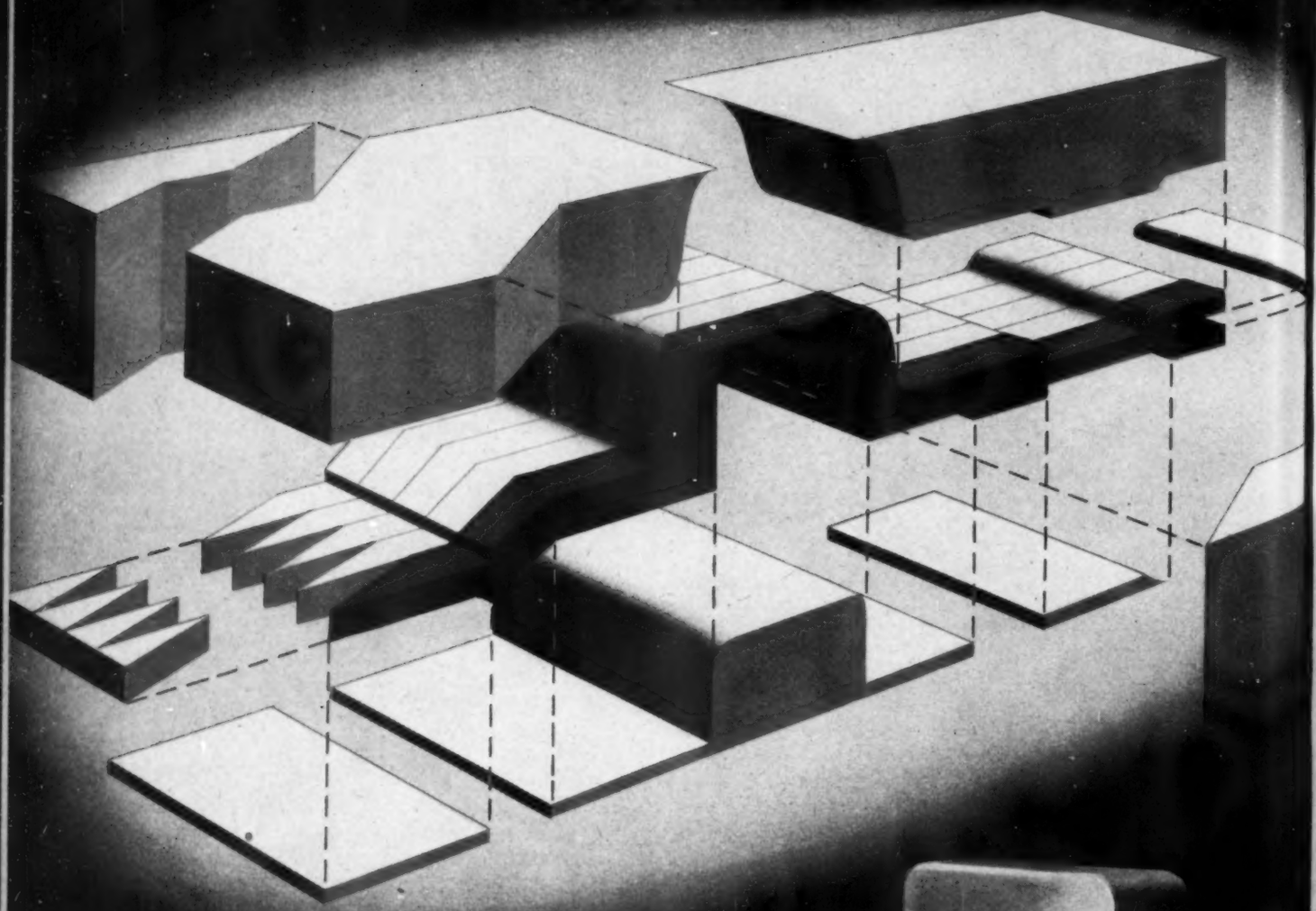
Equal Efficiency of Every Unit Makes the Balanced Machine

See our Condensed Catalog in Sweet's File.

THE CINCINNATI BICKFORD TOOL CO. **Cincinnati 9, Ohio U.S.A.**

YOUR PRODUCTION COSTS
with DoALL Contour Sawing

WORLD'S FASTEST METAL-REMOVING PROCESS



These 5 three-dimensional pieces, like the one in blue, were CONTOUR-SAWED in 16 hours by operators having only 3 days' experience. Saving made over previous methods was $600. Shape cutting can be done in a fraction of time required by any other machine cutting process.

DoALL CONTOUR SAWS, in world-wide use, make many amazing production economies. 1 There's no appreciable setup time. 2 Unneeded metal is sliced off, not whittled away by slow chip removal. 3 Continuous precision cutting to within .005" of layout lines; no time-wasting backstroke. 4 Cutting of all materials including hard, tough metals, as much as 30" thick. 5 Internal as well as external cutting, curved or straight, at angles. 6 Infinitely varying speeds.

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American Machinist's Spot NEWS OF METALWORKING

Materials costs have risen $50 per unit since last November for one medium-priced car manufacturer. Inventories in many items have been high as a hedge against strike delays and material shortages. These inventories have been source of considerable profit because of the increase in their value during recent months.

The practice of swapping motors for steel has grown among a few metal fabricators who find themselves long on one item and short of the other. Motor builders are trying to end this practice by controlling rigidly the number of motors received by each customer.

In two months JANMAT (Joint Army-Navy Machine Tools) has earmarked 11,000 surplus machine tools for military reserve, of which 5000 have been allocated to various services. Still to be selected by JANMAT tagging teams are 26,000 machines for Air Force, 12,500 for Army Ordnance, 26,000 for Navy Bureau of Aeronautics, 500 for Chemical Corps, 1200 for Navy Ordnance, 1400 for Navy yards and docks and 5400 for Navy reserve personnel training.

Some 2000 members of United Steelworkers, CIO, will attend one-week labor relations institutes planned for this summer by 10 universities. Courses will be given at Universities of Illinois, Indiana, Wisconsin, Michigan, Alabama and New Hampshire; Penn State and Antioch Colleges; and two West Coast colleges.

Accelerated depreciation for tax purposes has been recognized as justified in three recent cases by Tax Court, special court of appeal from decisions of Internal Revenue Bureau. Court has recognized validity of abnormal depreciation because of intensified use, has accepted overall statistics as evidence of intensified use, has accepted company and outside expert testimony, and may allow accelerated depreciation on all productive plant facilities.

> **Defense developments are centered about turbo-jet, rockets, missiles, atom power and electronics. Little is being done in armor and tanks. Chemistry of explosives never stops. Navy is concentrating on carrier planes, is not redesigning ships extensively because it believes atom bombs too expensive for enemy to waste on modern dispersed seapower.**

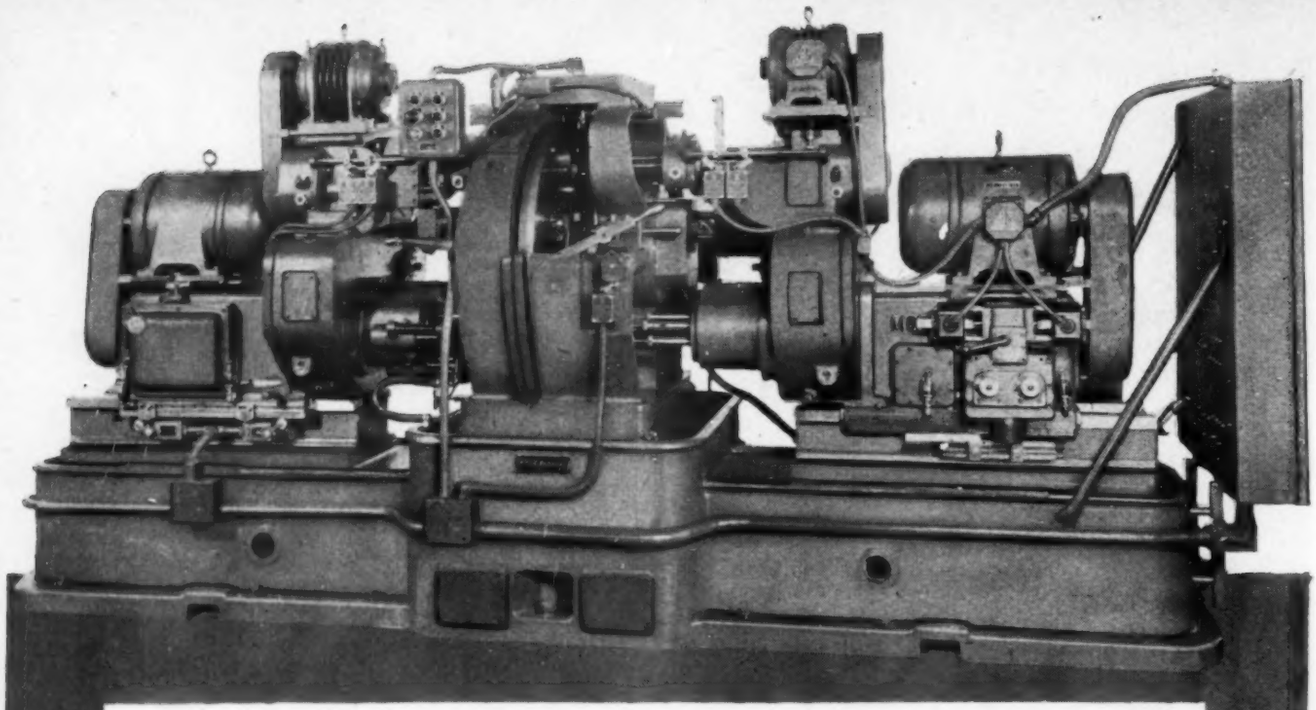
Long-range comfort about coal: U. S. coal reserves are estimated to be big enough to meet all the nation's energy needs at present rates for more than 1000 years (coal now furnishes only half the national energy consumption). Any possible fuel crisis is centuries away.

Detroit tool and die shops are said to be looking for work outside their own district, because of the dearth of automotive orders. Today's average skilled man in those shops gets $1.96 per hour. Semi-skilled and maintenance men average $1.32.

Straw in the price wind: one of nation's largest metalworking companies is avoiding accepting firm prices from suppliers unless nearby delivery is involved. Policy is to buy on basis of "market price ruling at time of shipment" with understanding that company will benefit from any price decline. Escalator clauses are being avoided.

Carbon steel ingots are being produced in electric furnaces at behest of automotive companies and other steel users who are short of sheet tonnage. Sheet bars then are placed outside with rolling mills for conversion into sheet form. Cost of such steel is very high, but is justified as means of avoiding shutdowns of plants employing thousands of workers.

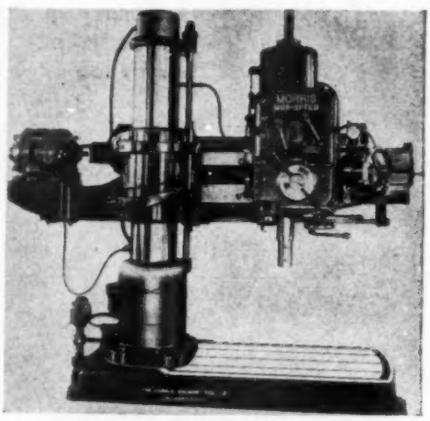
Metal alloys are being tested for strength under high heat in jet compressors and turbines. Metal discs, heated by electric coils, are rotated up to 35,000 rpm or until they break.



OPERATION AUTOMATIC ON THIS MORRIS MOR-SPEED HIGH PRODUCTION MACHINE

● This machine is a two-way horizontal drilling and tapping machine for handling refrigerator compressor parts. It has a five station automatic indexing turret with hand clamp fixtures. There are ten drilling spindles on the left hand head while the right hand head has ten drill spindles and three tap spindles. Head approach and feed is accomplished by self-contained hydraulic units.

When your work requires high production at low costs to meet competitive markets consult Morris. They have the engineering "know-how"—mechanical experience—and operating facilities to develop machines for specific purposes.



MORRIS MOR-SPEED RADIAL

Builders of MOR-SPEED Radials

The MORRIS Machine Tool Co.

CINCINNATI 3, OHIO

American Machinist

MAGAZINE OF METALWORKING PRODUCTION ★ ESTABLISHED 1877

Henry Ford

The man who symbolizes mass production to America and to the world is dead.

Henry Ford passed away suddenly. Not many hours before his death he had toured the Rouge plant which he had built from a marshy waste land into the largest single manufacturing unit anywhere.

He did more than any other man in history to bring to industry the benefits of mechanization. It was this mechanization which made possible higher productivity per man and in turn higher wages.

Back in 1914 Mr. Ford startled the world by establishing a minimum wage of $5 a day. He recognized even then that if people were to have enough money with which to buy automobles, they must be paid the highest wages.

He saw clearly that high wages and high productivity per man go hand in hand and that one cannot stand long without the other.

Mr. Ford probably was the first advocate of the theory that prosperity is possible only by faithful adherence to a policy of more goods for more people at lower prices.

Unfortunately for the national welfare, too many unionists and too many manufacturers today have lost sight of this cardinal principle which lifted Mr. Ford from obscurity to the pinnacle of industrial fame.

Mr. Ford taught the world's industrialists many things. He proved that subassembly and assembly line methods of manufacture could be used to turn out good products made to remarkably close tolerances.

He proved that it was unnecessary for workmen to pull and tug and lift heavy pieces of work all day, because mechanical means were better and faster.

He proved that conveyorizing of factories was of benefit to everyone, because it enabled workers to produce more goods with less effort.

He proved that the more machines could be designed to do the work formerly done largely by hand, the greater would production be, the lower the cost and the lower the selling price.

He proved that men do not have to work ten or twelve hours a day to earn a good wage; and he prove it at a time when the eight-hour day was unheard of.

In his small shops up and down southern Michigan, Mr. Ford demonstrated the feasibility of establishing industrial units in small villages where workers would have enough living space to grow their own food and would have "one foot in the soil and one in industry."

Mr. Ford showed that high-production machine tools and the most modern materials-handling techniques can be used profitably in these small shops as well as in the huge, sprawling Rouge works.

He early gave the lie to the old belief that industrial plants had to be dirty. Every Ford plant from the beginning was a model of cleanliness.

Beyond all of these accomplishments, Mr. Ford did more than any other one man or group of men to put America on wheels. He helped revolutionize transportation and, as a result, our way of living.

It is doubtful whether many people realize the impact that this man, who devoutly believed in the simple life, has had not only on industry, but on our social and economic system.

As one writer has put it, every assembly line, every conveyor belt, every industry which now subscribes to the belief that high wages and high production and low prices go hand in hand, is a living memorial to Henry Ford.

Burnham Finney

EDITOR

① Closing end fin.

② Trimming and notching corners.

③ Piercing and forming Prestoles.

④ Forming end flange.

Four Operations

ONE STROKE

Courtesy of Surface Combustion Corporation, makers of Janitrol Unit Heaters.

Progressive operations on Cincinnati Press Brakes reduce time and cut costs. They are one type of the almost endless applications of these machines.

Here we show a typical example of the profitable application of progressive, simultaneous operations. Four operations are completed on the first stroke; three on the second.

We suggest you write our Engineering Department about your individual forming problems, or call our representative near you for advice and suggestions.

Write for Catalog B-2.

THE CINCINNATI SHAPER CO.

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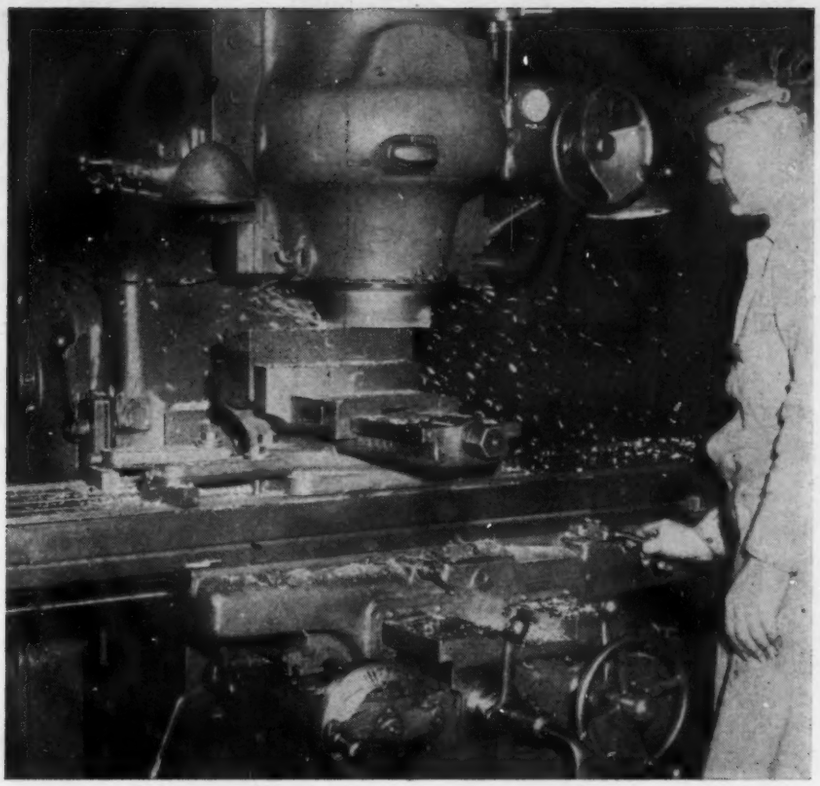


How to Set Up CARBIDE MILLING JOBS

By H. A. FROMMELT, CONSULTING ENGINEER

CARBIDE milling is considered by many production engineers as, by far, the most important modern machining development and the one most likely to have the greatest effect in increasing worker productivity and reducing manufacturing costs. But converting to carbide and applying it without realizing the decided advantages it offers can only result in halfway progress, in mediocre benefits, in far from the most efficient machining and processing of parts. To encourage effective application of carbide cutters and the new carbide milling technique, an entirely different, but workable, approach to setting up of carbide milling jobs is presented in this report. Ten consecutive steps form the basis of approach.

A SPECIAL American Machinist REPORT TO THE METALWORKING INDUSTRIES

10 Steps to Setup Success

CARBIDE APPLICATION and a successful carbide-milling technique must necessarily change the approach to, and production scheduling of, milling operations, particularly on iron and steel. If full value of carbide milling is to be realized by production departments, the nature of the metal-removal revolution must be appreciated and applied.

Until recently, milling was subject to inherent limitations in cutting materials. But no longer, for all practical purposes, do limitations exist in the power they can apply.

As much as 100 hp. can be applied through an 8-in. face mill with excellent carbide life. It is therefore now possible to disregard cutting-material limitations and to establish operating characteristics on the remaining limiting factors, such as available horsepower and known limits of surface cutting speed and chip, or tooth, loads.

The change in technique is revolutionary. Unless the teaching of experience, research and development is heeded, the full benefit of carbide milling will not be enjoyed.

This applies to the surface speeds that must be chosen for various materials, tooth loads to be selected, cutting angles to be specified and metal-removal rates that can, and should be, called for to permit the most efficient machining and processing of components.

There being no known limit to the amount of power that can be applied through a carbide mill to remove metal, is the basis for the current revolution and the reason for approaching the evaluation of milling operations in an altogether new and yet sound method.

Ten steps should be taken to set up a carbide-milling operation. In order of application, these are:

1. Identify and classify material.
2. Select surface speed.
3. Select cutter type and diameter.
4. Determine metal-removal rate of the workpiece.
5. Correlate metal-removal rate with horsepower available in the milling machine designated for the job.
6. Establish feed rate from the foregoing data.
7. Check tooth load.
8. Specify milling method (conventional or climb), holding method or fixture, chip disposal, etc.
9. Establish cutter care and grinding procedure.
10. Check surface and tolerance specifications and their influence on metal-removal rate.

1 IDENTIFY AND CLASSIFY MATERIAL

The first and perhaps the most important step in the proper approach to a carbide-milling operation is identification of material in the workpiece. On it depends the proper interpretation of later data and the correct specification of remaining factors in the setup.

By identification and classification of workpiece material is meant placing the component in one of the following categories:

Wrought iron.
Low-carbon steel.
Stainless steel.
Standard SAE steels, beginning with SAE 1015 or 1020.
Cast steel.
Cast iron—unmodified and uncontrolled.
Cast iron—modified as semisteel or controlled as Meehanite and Linite.
Cast iron—special, as white or chilled iron.
Malleable iron.
Non-ferrous materials, such as aluminum, magnesium and their alloys, copper and its alloys and plastics.

Identifying and classifying the workpiece material correctly makes possible the selection of the surface speed that will give best results in terms of cutter life and performance.

TABLE 1

Milling Speeds for SAE Steels

Brinell Hardness	Surface Speed sfpm.
160—180	624—593
180—220	593—536
220—300	536—447
300—420	447—338

2 SELECT SURFACE SPEED

The surface speed should be chosen independently of the type of milling machine, the kind of cutter selected (provided only it has suitable carbide tips—brazed or solid) and the horsepower available in the machine. Selection should be based solely on the foregoing classifications of these materials and, under no circumstances, should it be changed to suit other operating characteristics.

For wrought iron, the surface speed should be from 900 to 1,000 sfpm. Unless relatively high surface speeds are selected, the milling operation on wrought iron will fail.

For low-carbon steel, with from 5 to 15 points of carbon, the surface speed should be from 600 to 900 sfpm. Applying recommended surface speeds for standard steel to low-carbon steel invites failure.

Stainless steel, such as Type 304 (without sulphur), calls for a surface speed of 900 sfpm. All other stainless steels should follow recommendations for standard steels.

For standard SAE steels, the surface speed should be based on the Brinell hardness, as in Table I. It is important that the actual Brinell hardness be determined, either from specifications or better still by actual test by a portable Brinell tester.

For cast steel, the surface speed is critical—about 300 sfpm. and generally not higher than 350 sfpm. Cast steel must not be confused with forged or rolled steel. It is milled much the same as other cast materials, such as cast iron, as far as the surface speed is concerned. The sandy character of the skin determines the rate at which this material can be milled by carbide.

For unmodified cast iron, which has a tensile strength of approximately 25,000 to 30,000 psi., surface speed should lie between 300 and 450 sfpm.

Modified and controlled cast irons, such as semisteel, Meehanite and Linite with tensile strengths specified at approximately 50,000 psi. and even higher, call for surface speeds no higher than 300 sfpm. Higher strengths require lower surface speeds. These materials can usually be detected readily by a Brinell test—from 180 to 220.

Special cast irons, such as chilled or white iron, are milled at surface speeds from 100 to 250 sfpm. Their Brinell hardness varies from 500 to as high as 700. For the latter, a surface speed of not over 100 sfpm. should be specified.

Malleable irons should be milled at rates between 350 and 450 sfpm.

For non-ferrous materials and plastics, selection of the surface speed depends entirely on the spindle speeds available in the milling machine being used. As far as is known, there is no limit to the surface speeds at which these materials cannot be milled successfully.

Surface speeds as high as 20,000 sfpm. have been successfully applied in actual shop operations, and aluminum and magnesium components are being milled regularly at rates as high as 10,000 sfpm. Spindle speeds to provide such rates are now available in standard millers.

The vast majority of machines, however, have top spindle speeds from 1,000 to 2,000 rpm. The highest speed available in such equipment should be designated for the operation, and other operating characteristics adjusted accordingly.

3 SELECT CUTTER TYPE AND DIAMETER

The size of the job to be milled is known; the faces to be machined are dimensioned. From this information the cutter size is selected. Where clearances present no limitations, the ratio of cutter diameter to face dimension should be approximately 5 to 3.

Thus, if a piece 3 in. wide is to be milled, a 5-in. dia. cutter is selected. A workpiece face 5 in. wide should be milled with a cutter at least 8 in. in dia. A 10-in. cutter should be chosen for workpieces from 6 to 7 in. wide. Above 7-in, a 12-in. cutter should be chosen.

A cutter diameter larger than the largest effective gear in the milling machine should never be selected. It is, therefore, seldom justifiable to use a cutter larger than 12-in., unless the job is being performed on the larger bed and planer-type mills, which have bull gears about 16 in. in diameter.

Unless this most important recommendation is observed faithfully, the flywheel effect in the cutter will be greater than that in the gear train and backlash will be brought into play with each tooth entrance and exit. But if the effective gear is larger than the cutter, the flywheel effect will be greater in gear than in cutter and backlash will not play so important a part.

But selection of cutter does not end with the proper diameter. It is important that the proper grade of carbide and proper cutting and clearance angles always be specified.

Grade specification can safely be left to carbide manufacturers by following their recommendations, charts and data sheets based on research, development and experience. If an unusual milling operation presents itself, experimentation should not be undertaken without the manufacturer's help and advice.

Table II gives recommended cutting and clearance angles, based on proved experience and results. The 15° face relief angle for milling of wrought iron, low-carbon steel and stainless steel (Type 304) is considered critical. Without such a clearance angle, cutter life will be most uneconomical. Negative cutting angles are recommended for all cast iron with Brinell hardness above 180 for the same reason.

All cutting angles are given as "true" rake; that is, the combination of radial and axial rakes should be as noted. Frequently the true rake is made up of 7° negative radial rake and 7° negative axial rake in combination with a 15° nose angle. This results in a negative true rake of approximately 7° and is frequently used for milling steel.

The combination (Fig. 1) of 10° positive radial rake, 7° negative axial rake and a 15° nose angle is used for an 8° positive true rake angle for the milling of unmodified cast irons. The combination of 15° positive ra-

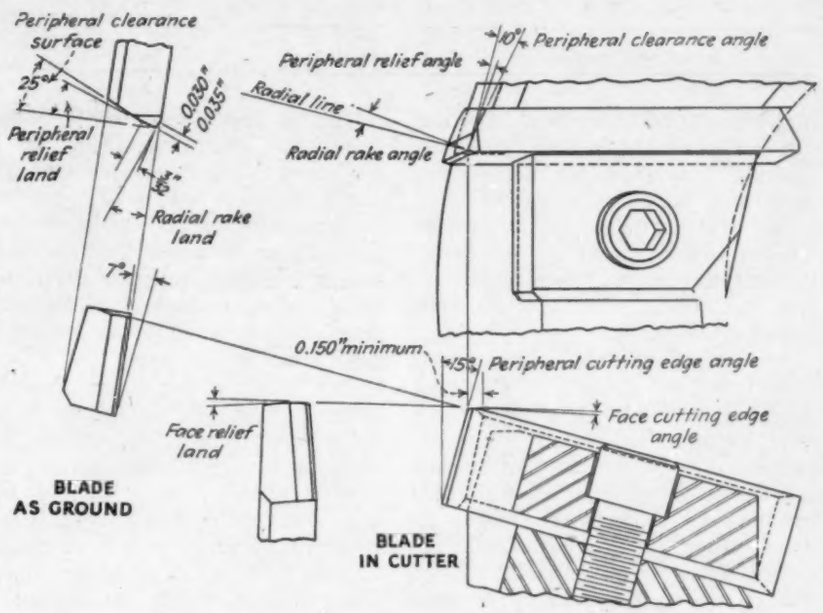


Table II—Cutting and Clearance Angles

Material	Cutting Angles in Deg.	Clearance Angles in Deg.
Wrought Iron	10 PRR—7 NAR 8 PTR	7 OD—0 FCE 15 FR
Low-carbon Steel	10 PRR—7 NAR 8 PTR	7 OD—0 FCE 15 FR
Stainless Steel	10 PRR—7 NAR 8 PTR	7 OD—0 FCE 15 FR
Standard Steel	7 NRR—7 NAR 7 NTR	7 OD—0 FCE 7 FR
Unmodified Cast Iron	10 PRR—7 NAR 8 PTR	7 OD—0 FCE 7 FR
Modified Cast Iron	7 NRR—7 NAR 7 NTR	7 OD—0 FCE 7 FR
All Ferrous Materials Harder than 300 Brinell	10 NRR—7 NAR 8 NTR	5 OD—0 FCE 5 FR
Non-ferrous Materials	15 PRR—7 NAR 12 PTR	7 OD—0 FCE 15 FR

Note:
PRR—Positive Radial Rake
NRR—Negative Radial Rake
NAR—Negative Axial Rake
PTR—Positive True Rake
NTR—Negative True Rake
OD—Outside Diameter, or Peripheral Clearance
FR—Face Relief, or Clearance
FCE—Face Cutting Edge, or Dish

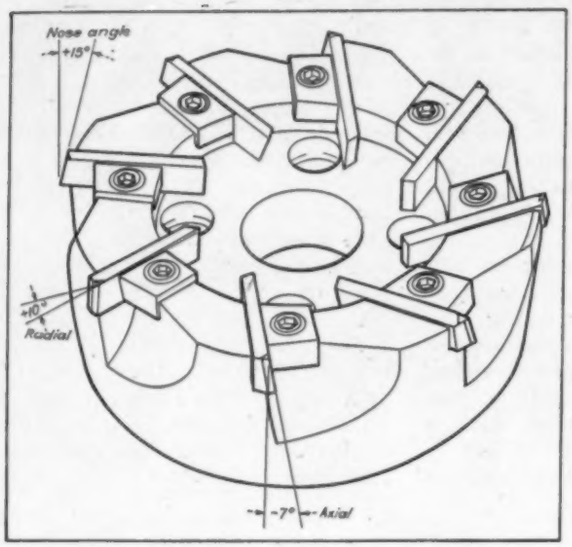


Fig. 1—True rake angle is determined by the combination of radial, axial and nose angles, which vary according to material machined

dial rake, 7° negative axial rake and a 15° nose angle is used for a 12° positive true rake for non-ferrous materials, including plastics.

An excellent rule to follow for true milling economy is this: Select the simplest cutter, the least expensive and one that requires the least complicated setup.

A cutter that can be assembled directly on the spindle of a milling machine, rather than with a setup that requires an arbor, is recommended. A face mill set on the spindle of a vertical or horizontal machine is, experience shows, always preferable to a cutter that requires mounting on an arbor. Arbors deflect, are time-consuming in their setup and the cost of grinding and reconditioning such a cutter assembly is greater than that of a cutter mounted on the spindle.

Selection of straddle mills is not recommended, unless there is no other way to perform the operation. They are usually selected because of the apparent advantage of milling two sides of a component at one pass. But carbide milling has so reduced cutting time that the time to make the arbor setup for straddle mills is no longer justified.

It is better to mill one side of a piece at a time with a simple face mill, turn the piece manually, or mechanically in a fixture, and mill the other. When the time to dismantle and reassemble a straddle-mill setup for grinding and reconditioning is taken into account, floor-to-floor times is always greater than when a simple face mill is mounted on the spindle to mill but one face at a pass.

This is best illustrated by examining an operation (Fig. 2) on an electric-motor component. The work, a piece of hot-rolled steel 2 × 3 × 16 in., is milled on both sides to an inverted T shape. Formerly the operation was performed with high-speed-steel straddle mills, thus making possible the milling of both sides at one pass.

But this operation of removing from each side a section of metal, 0.310 in. wide and 2.75 in. deep, was done at ½ ipm. With carbide, one side is milled with a simple 4-in. diameter face mill at 35 ipm. It now requires less than 10 min. to change cutters, compared to ¾ hr. to replace straddle mills. Less than 20 min. is needed for cutter reconditioning, compared to a former 2 hr.

Moreover, the two cutters in a straddle-mill setup never dull equally, yet the assembly is torn down when one cutter is dull. The time has been reduced on the above operation from 10 min. to 30 sec. for cutting, from 2 hr. to 10 min. for cutter change and from 2 hr. to 20 min. for cutter reconditioning. Finally, the straddle mills cost about $300, whereas a 4-in. face mill costs less than $50.

4 DETERMINE METAL-REMOVAL RATE

After the cutter has been selected, the next step in setting up a carbide milling operation is to determine the metal-removal rate of the workpiece. This means an evaluation of the component with regard to its thickness of section, ribbing, buttressing and general freedom from vibration and distortion when cutting forces are applied.

Cutting forces tend to distort the workpiece and, under severe conditions, actually to set it vibrating. So the metal-removal rate means the ability of the work to take the beating it is subjected to while in the cut.

Distortion and vibration are aggravated by the necessity for clamping the work to the machine table or in a fixture. Every point of contact of clamp and workpiece is a point of distortion.

The work tends to bow or give in this area and, when clamps are released, to spring back into position. The greater the cutting force in conjunction with the clamping pressures, the greater will be the distortion of the milled piece.

For some jobs this is no disadvantage in terms of accuracy demanded and obtained. But if tolerance specifications are close, both as to accuracy and surface finish, then these points must be given full consideration by production personnel setting up the job.

Another factor to be analyzed is the distortion and vibration that result from cutter position with respect to supporting members of the machine. For example, the cutter in the setup shown in Fig. 3 would vibrate less if the large electric-motor frame mounted on the table of the horizontal boring machine could be brought closer to the column, but this is prevented by the nature of the frame and operation.

This extension is not at all extreme, some jobs requiring spindle extensions of 18 in. or even more. As no amount of ingenious planning can obviate this condition, it must be taken into account when the job is being estimated in terms of metal removal.

How much metal can be removed from a workpiece without setting up distortions and vibrations that will (1) greatly and drastically reduce cutter life, (2) decrease accuracy, possibly beyond specification limits, and (3) spoil surface finish? This question that the production planner must answer if the job is to be successful, can be answered correctly, only in terms of a rich and varied experience, preferably first-hand. No amount of second-hand information will ever take the place of coming to grips with these problems in the shop.

The difference in workpieces is obvious if a carburetor, usually a

thin-walled cast-iron body, is compared with the large 700-hp. motor frame in Fig. 3. In the former, less than 7 cu. in. can be milled each minute from the mating surfaces with the best of holding devices and fixtures. In the latter, boiler plate of low carbon content, more than 100 cu. in. can be removed each minute if power is available at the cutter. The carburetor cannot possibly have more than 3 hp. applied to it through a cutter, while the frame could easily withstand 50 hp.

Nature, design, construction and material specification of any job must be carefully studied by the planning personnel to determine the amount of metal that can be moved in a unit of time without damage to the piece or injury to the surface and accuracy specified.

5 CORRELATE METAL-REMOVAL RATE WITH AVAILABLE HP.

The next step is to determine the power available in the machine that can, or must be, used for this operation. What the component will withstand is one thing; what the available machine has to offer is quite another in the majority of setups.

Where machine power is less than that applicable to this job, this may be a problem for management consideration, particularly if the job lot size warrants making a capital investment. But where the machine has more power than the workpiece is capable of absorbing, the job should be transferred, if possible, to more suitable equipment.

Using all the power built into expensive machine tools contributes greatly to over-all manufacturing economy. Accurately equating machine power to the power that can be absorbed by the workpiece cannot be fully done in every operation, particularly in a jobbing shop or where operations are on anything but a mass-production basis. Nevertheless, setups should be planned to eliminate any operation at much less than rated capacity.

6 ESTABLISH FEED RATE

The feed rate can now be established from available data. Assume that 20 hp. is available for an operation and that the workpiece (steel) is capable of absorbing this power without distortion or poor surface conditions. Further assume that face width to be milled is 5 in. to a depth of 0.125 in.

The sectional area of the cut is ⅝ sq. in. If the K-factor (horsepower required to remove 1 cu. in. per min.) of the steel to be milled is 0.5, the 20 hp. available in the machine tool will move 40 cu. in. per min.

The feed rate is then determined by dividing metal removed per minute by the area of the cross-section, or $40 \div \frac{5}{8} = 64$ ipm. This feed rate is high and beyond the range of practically all equipment, except some recently designed tools for carbide milling. Further consideration will be given directly to a change in the feed rate.

When the amount of material to be removed is considerable in depth, the production planner must determine what depth of cut should be taken. The approach to this problem is exactly the same as that made in establishing feed rate.

Assume, for example, that from a large casting, such as a machine-tool bed, the irregularities or "waves" in the surface are such that at least ½ in. must be removed. The question that arises as to the economy of several or more cuts, as opposed to one cut, must be answered on the basis of facts.

The semisteel bed to be machined is 50 in. wide by 120 in. long, and from its top surface ½ in. of metal must be converted into chips. Shall a cut of the full ½-in. depth be taken, or shall a number of shallower cuts be made? Also, in milling the 50-in. wide surface, is it better to use an 8-in. cutter to take eight cuts, each 6¼ in. wide, or a 12-in. cutter to take five cuts, each 10 in.

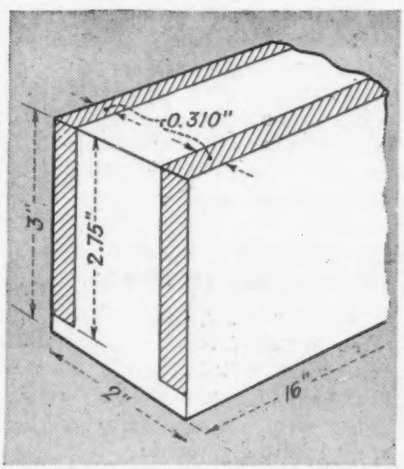


Fig. 2—Milling this inverted hot-rolled steel T shape, one side at a time, is done with a 4-in. carbide face mill at 35 ipm. compared to 1/2 ipm. for high-speed-steel straddle milling

These questions are simply answered if an analysis is made. Twenty horsepower, at 0.5 K-factor (semisteel), equal a removal rate of 40 cu. in. per min. With a ½-in. depth of cut, the sectional area of cut is 2½ sq. in., giving a feed rate of $40 \div 2.5 = 16$ ipm. With this feed rate and an 8-in. cutter, eight cuts, each 8 min. long for the 128-in. length, will require 64 min. of actual cutting time.

With an 8-in. cutter and a ⅛-in. depth of cut, the 64-ipm. rate can be applied. The number of cuts then increases to 32 (8 in width and 4 in depth). Each of these requires 2 min., for a total cutting time of 64 min. The cutting time is the same as in the first case, but as the cutter makes 32 trips instead of 8 to return to its starting point, the return time is increased 4 times.

As the rapid-traverse rate on large machines is usually 150 ipm., the dead time of cutter travel for repositioning is 32 min. for the 64-ipm. rate and 8 min. for the 16-ipm. rate. The total cycle time therefore is 72 min. with the 16-ipm. rate and 96 min. with the 64-ipm. rate.

Examining the difference in time between use of a 12-in. cutter and the 8-in. cutter shows that, with a 12-in. cutter for a 10-in. cut at ⅛-in. depth, the feed rate is 32 ipm. to remove 40 cu. in. per min.

Using the same cutter, for 10-in. cuts at ½-in. depth, the feed rate decreases to 8 ipm. to remove the same amount of material in a minute. But the 12-in. cutter makes 5 trips across the 50-in. base when milling to a ½-in. depth, while it must make 20 trips if milling to the ⅛-in. depth.

At 32 ipm. the cutting time is 4.1 min. per pass or 82 min. total cutting time. At a rapid-traverse rate of 150 ipm., the repositioning time for 20 trips of the cutter is approximately 20 min. Hence, the total cycle time is 102 min.

At 8 ipm. the cutting time per pass is 16.5 min. and the total cutting time for 5 passes is 82.5 min. But the re-cycling time is now reduced from 20 to 5 min., and therefore the total cycle time is reduced from 102 to 87.5 min. The 8-in. cutter is more economical than the 12-in. cutter by the difference between 87.5 and 72 min.

Moreover, use of an 8-in. instead of a 12-in. cutter is recommended from the standpoint of machine maintenance. There is less backlash effect with the smaller cutter and therefore less impact on gear trains

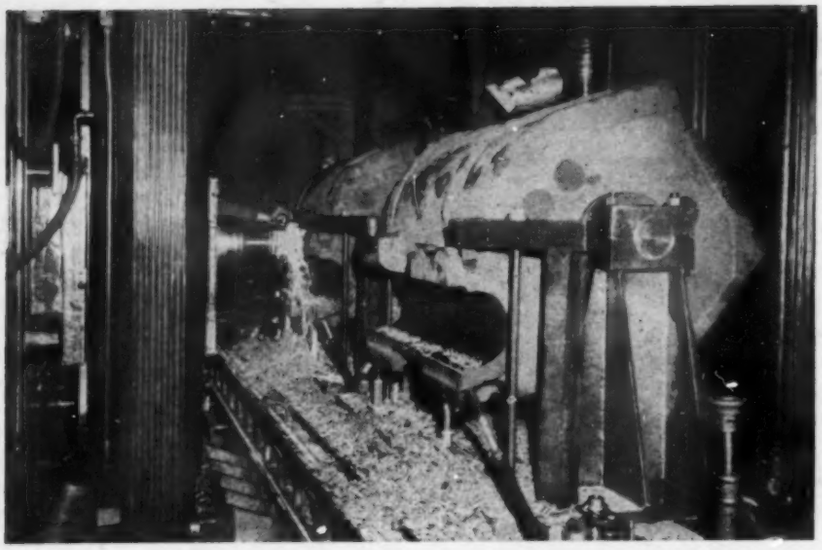


Fig. 3—An electric-motor component, milled on a horizontal boring machine, is held in a trunnion fixture so it can be rotated for necessary cuts. Cutter position introduces vibration that could be avoided in a bed-type milling machine, either side or cross-rail

and bearings. A 6-in. cutter would have still less backlash effect, but similar calculations show that it would require 156 min. for ⅛-in. cuts, 4 in. wide, and 91 min. for ½-in. cuts.

The data can now be tabulated:

Cutter Dia. in.	Time, min. (⅛-in.)	Time, M.n. (½-in.)
6	156	91
8	96	72
12	102	87.5

The superiority of the 8-in. cutter taking ½-in. cuts is marked. The minimum time of 72 min., compared with the maximum of 156 min. required for a 6-in. cutter taking ⅛-in. cuts, represents a saving of 53% on the same job using the identical technique, but with the selection of the cutter made on a rationalized, rather than a guess-work, approach.

7 CHECK TOOTH LOAD

The seventh step in setting up a carbide-milling operation is checking the tooth load, also called the chip load or chip thickness. It is necessary to determine whether the tooth load is in line with good milling practice.

Calculation of tooth load is made by dividing feed rate by number of cutter teeth times spindle speed. By applying this calculation to the foregoing example, the following results are obtained:

Cutter Dia., in.	Feed, ipm.	Tooth Load, in.
8	64	0.026
8	16	0.0065
6	80	0.030
6	20	0.0085
12	32	0.012
12	8	0.0035

All but the last of these tooth loads represent good practice. If it were necessary therefore to use a 12-in. cutter, the depth of cut should be made less than ½ in. with a corresponding increase in the feed rate to bring the tooth load up to 0.010 in.

The necessity for checking the tooth load is evident from this analysis, as a chip thickness of 0.0035 in. would result in poor cutter life.

8 SPECIFY MILLING METHOD

Climb milling, experience indicates, should always be used if the equipment will permit. Standard machines of recent design are provided with adjustments that make climb milling possible.

The wear between the table screw and nut must be compensated for to prevent the climb method from pulling the workpiece into the cutter and wrecking the cutter and, sometimes, even the machine. The amount of this pull-in will equal the wear between screw and the nut. If this is as much as 0.030 to 0.060 in., the thickness of chip that the cutter will attempt to take is so great that damage will be done.

In climb milling the chip thickness is maximum at the beginning of the cut, and the cutting forces, in an arbor setup, are directed downward against the solid base or table of the machine. As these advantages are considerable, climb milling is always to be preferred if the machine tool is properly equipped.

9 ESTABLISH CUTTER CARE AND GRINDING PROCEDURE

Economy in cutter maintenance demands establishing a procedure for removing grinding, reconditioning and routing cutters. They must be taken from the machine when dull, moved to the grinding crib, ground as specified, and returned to the job, if a continuing production operation, or to cutter storage.

Above all, it is essential that the kind of carbide and the cutting and clearance angles be specified on a tag form tied to the cutter, and the machinery set in motion to have the operations performed as directed on the forms. Reasonable precautions must be issued for the proper handling of carbide-tipped or bladed cutters, as their cutting members are much more fragile and subject to fractures under sudden blows than the more generally used and better known high-speed-steel mills.

10 CHECK METAL REMOVAL AGAINST SURFACE AND TOLERANCES

Specifications for tolerances and surface finish must be checked against those of the first pieces coming from the machine. The feed rate established on the basis of the component construction and the machine power may result in too large a chip load for good finish.

If a zero face cutting edge angle is used and if the length of this zero line, or face cutting edges, is equal to the feed per revolution, or somewhat greater, and if the rigidity in the entire setup prevents vibration, then the finish should be ideal, regardless of the feed rate, depth of cut or other operating characteristics. But machine condition, nature of workpiece and other factors affecting the metal-removal rate must be taken into consideration when checking finish and accuracy.

How to Determine Metal-Removal Rate

DETERMINATION of the metal-removal rate will be expanded in its relationship to available horsepower, feed rate and tooth load before practical examples are given to illustrate application of the ten steps to setting up carbide-milling operations.

As determination of the metal-removal rate can only be based on knowledge of the ability of a workpiece to withstand cutting forces, examples of practical evaluations are presented to aid the planner in his approach to the problem and possible solution.

Machining Meehanite Block

A die-backup block, Fig. 4, is a 10-in. casting of Meehanite, with a specification of 50,000 psi. and a Brinell hardness of approximately 185. Considerable metal must be removed to bring this cast component to size.

The K-factor for Meehanite can safely be taken as 0.5. Little experience is required to conclude that this workpiece can withstand any metal-removal rate applied to it. Limitations, if any, must be sought elsewhere.

No obstacles are uncovered in the holding method which can secure the block to the milling table against all cutting pressures. With no limits inherent in the job or its holdability, available power in the machine can be equated into cubic inches of metal that can be removed each minute.

The 50-hp. motor on the spindle can, according to the K-factor, remove 2 cu. in. of Meehanite for each available horsepower, or a total of 100 cu. in. per min.

As a reasonable commercial finish only is specified, with no mention of accuracy, no limitations are imposed by tolerance and surface-condition specifications and the full 50 hp. can be applied to removing material from the die block.

It is now necessary to check back to determine whether tooth loads and other operating characteristics are in line with good milling practice.

Calculating Removal Rate

An 8-in. cutter having 8 blades is mounted on the spindle. The depth of cut specified is 0.350 in. and the width of cut selected is 5 in. The sectional area of the cut is therefore 1.75 sq. in. and the feed selected is the top reading of 60 ipm. The metal-removal rate therefore is 105 cu. in. per min., making the spindle-motor horsepower requirement slightly over 50.

Operating characteristics of this setup thus far are considered excellent. There remains the tooth load. At 60-ipm. feed and 200-rpm. spindle speed (400 sfpm. approximately), load per tooth is $60 \div (8 \times 200) = 0.037$ in.

Higher Cutter Life

Tooth load is heavy but not excessive. In fact, with this job and equipment, a tooth load of 0.037 in. is not only not excessive but is likely to result in an increase in the cutter life.

It is interesting and instructive to consider the results of applying 100 hp. to this milling job if such a spindle were available or if it were considered feasible temporarily to overload the equipment as much as 100%.

By leaving all factors unchanged except the power and hence the metal-removal rate, the feed rate

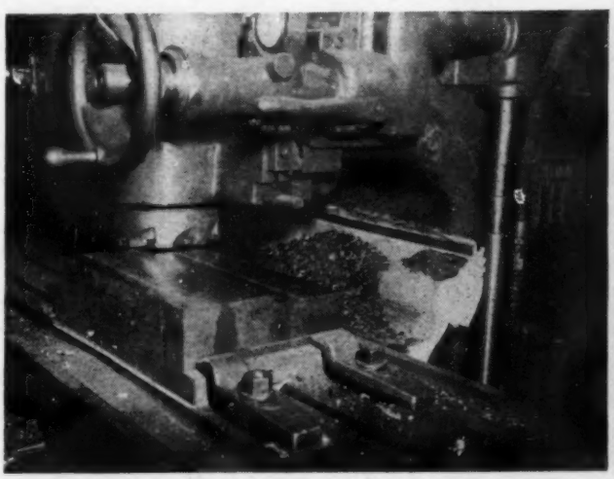


Fig. 4—Meehanite die-backup block, of 0.5 K-factor, can take a 105-cu. in. per min. metal-removal rate at 4,000-sfpm. surface speed, 60-ipm. feed and 0.037-in. tooth load with a 50-hp. machine. Doubling the power available would double the metal-removal rate, with a 12-in. instead of an 8-in. cutter

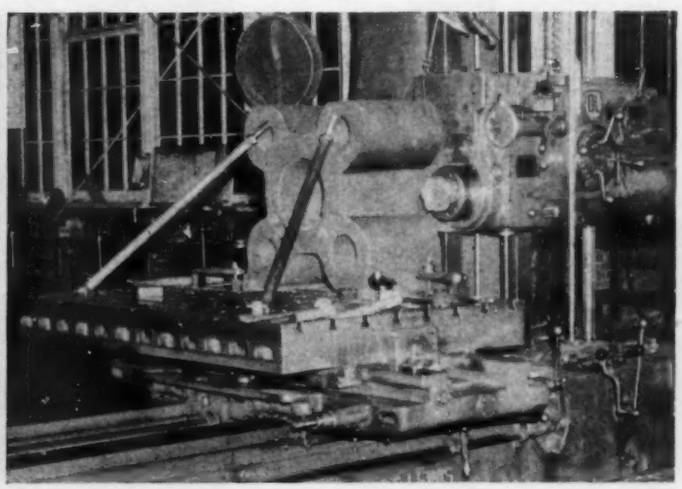


Fig. 5—Holdability of this gray-iron casting and high cutter position limit the metal-removal rate to 50 cu. in. per min. even though the casting could withstand a higher rate. At a K-factor of 0.5, the 25 hp. available are all applied. Accuracy and finish tolerances are liberal and allow the 50-cu. in. removal rate

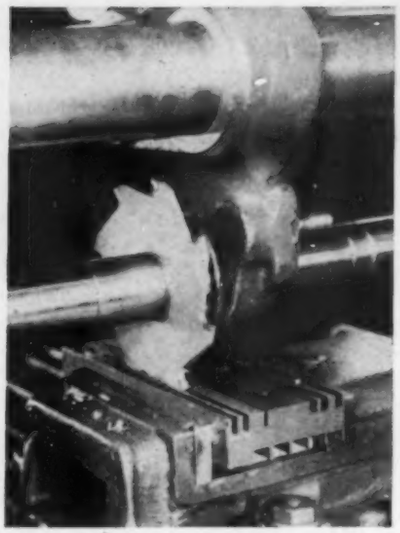


Fig. 6—Milling a 0.020-in. slot at 20-ipm. feed and 0.250-sq. in. cross-section of cut means only a 5-cu. in. per min. removal rate

and tooth load would be doubled. It is not advisable to increase surface speed, already slightly over 400 sfpm., somewhat above the customary 300 sfpm. usually selected for Meehanite and similar cast materials.

The resulting feed rate of 120 ipm. and tooth load of 0.074 in. are, of course, excessive. Moreover, the feed rate is not available on this machine. Obviously some changes must be made in the setup to compensate for these conditions.

Increase Cutter Diameter

The first point to consider is the cutter diameter. It can be increased to 12 in. with a cut 10 in. wide to sweep the entire workpiece face width in one pass instead of the previous two passes. Feed rate and tooth load can be reduced accordingly.

If depth of cut remains the same at 0.350 in., sectional area of the cut is 3.5 sq. in. At the top feed rate of 60 ipm., removal rate is increased to 210 cu. in. per min. With a K-factor of 0.5, this metal-removal rate uses all available power in the spindle motor.

Size of workpiece does not necessarily imply a limitation in metal-removal rate. This is proved by the operation shown in Fig. 2. The amount of metal to be removed in cross-section is 0.310×2.75, or approximately 0.86 sq. in. plus. The K-factor for this low-carbon steel (Brinell 120) is 0.5. If a 60-ipm. feed rate is applied, removal rate is $0.86 \times 60 = 51.6$ cu. in. per min. and the amount of power demanded is therefore approximately 26 hp. This is verified by Esterline-Angus meter readings.

As far as metal removal is concerned, there are no inherent limitations in the workpiece itself. Certainly a piece of steel $2 \times 3 \times 16$ in., if properly held, will not vibrate or distort.

Check Clamping

Holdability of the workpiece is excellent. As this is a high-production job, a fixture has been devised in the form of a sturdy angle plate with cam-locking clamps that hold the piece securely and yet clear the cutter. Only one side of the inverted T is milled at a pass. The component is reversed and the other side milled.

This is preferable to straddle milling, calling for an arbor which, however rigidly and well supported, would distort and vibrate. As the 4-in. face mill is mounted direct to the spindle of a horizontal milling machine, the relationship of cutter and workpiece is ideal and the metal-removal rate, from this aspect, can be set at a maximum.

With no limitations in either the workpiece or its method of being held, full power of the spindle can be applied. The tooth load using a surface rate of 1,000 sfpm., and therefore a spindle speed of 960 rpm., is slightly over 0.015 in. This yields an excellent finish and the tolerances, reasonably close, are all met fully and completely and with a cutter-life record more than five times greater than with other cutting materials.

As power required with a 60-ipm. feed is about 26 hp., this operation should be scheduled for a 30-hp. milling machine, which will provide adequate power at all times for the metal-removal rate of 51 cu. in. per min.

An entirely different set of conditions are encountered in large components. The gray-iron casting in Fig. 5 has a strength of not over 25,000 psi. Its machinability is as ideal as any cast material can be, and the job is scheduled for a large horizontal boring and milling machine with a motor capacity of 25 hp.

There is no inherent weakness in the workpiece. Its sections are heavy and, while it is designed with cored areas, there should be no resulting vibration or distortion, regardless of the metal-removal rate selected.

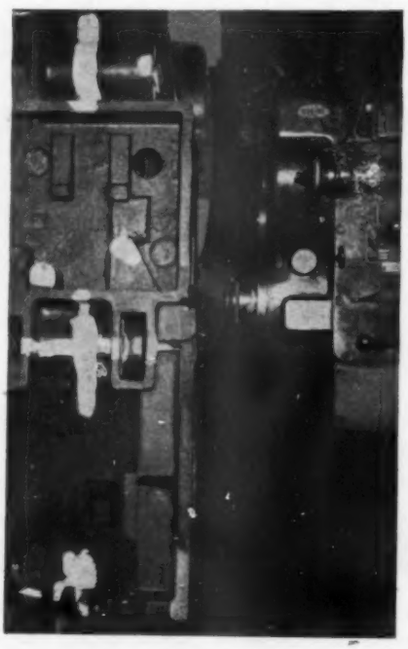


Fig. 7—High spindle position, work holdability and close tolerances limit removal rate to 15 cu. in. per min. and feed to 15 ipm.

Removal Rate Restricted

Holdability of the workpiece and relationship of cutter and spindle to the job leave much to be desired. Height of the casting makes it impossible to anchor it with absolute rigidity when milling top sections. Moreover, when the spindle is brought into position to mill top sections, rigidity of these machine-tool members is lost or at least partially sacrificed. Under these conditions experience indicates that a rate of removal of 50 cu. in. per min. is maximum for good milling practice.

A 50-cu. in. removal rate, using a 0.5 K-factor, results in a 25-hp. demand, which is the rating of the machine. Specifications for surface conditions and accuracy are sufficiently liberal to permit applying this metal-removal rate.

Determination of the 50-cu. in. metal-removal rate, after an analysis of the holdability of the component and the relationship between spindle and the job, is based on experience and cannot be substituted for by data or any other second-hand approach.

An extreme instance of the effect of cutter design and specification on the possible metal-removal rate

is shown in Fig. 6, a slotting job.

The 8-in. dia. slotting cutter has a body thickness of approximately 0.175 in. for a 0.020-in. slot. Thus, even with a slot depth of 1¼ in., feed rate, and hence removal rate, must be restricted. Sectional area of the cut is 0.250 sq. in., which at a 20-ipm. feed rate results in 5 cu. in. of metal removed per minute.

Here the limitations are in the cutter body, which tends to vibrate excessively at higher feeds. The material being slotted is SAE 1112, the machinability of which is reasonably satisfactory. The component is solid and can be held adequately against vibration and distortion resulting from these relatively light cutting pressures.

The milling machine is a standard No. 2 equipped with a 5-hp. motor. The power required for slotting is approximately 3 hp., and the K-factor for this type of operation is approximately 0.6, a reasonably good factor for this operation. The limiting feature therefore is the type of cutter that must be applied and its dimensional design determined by the job specifications, particularly the slot width.

Here it is impossible to use all the power available in a 5-hp. machine, even with the application of carbide. A 3-hp. machine would have been adequate, at least from the standpoint of power demanded.

Machine Utilization Pays

It is interesting to note, however, the more adequate utilization of the machine's capacity with carbide as compared with other cutting materials of traditional specification. A high-speed-steel slotter would have been operated at a maximum feed rate of 4 ipm. for this slotting job.

The metal-removal rate would therefore have been 1 cu. in. per min. Although the K-factor with this cutting material is conservatively 1¼, the horsepower demanded under these conditions would have been something under 1½. Approximately 25% of the power would be used with high-speed steel as a cutting medium, as compared with 60% with carbide.

With carbide, the limiting feature is solely in the cutter design imposed by the job specifications, while with high-speed steel it resides primarily in the cutting material.

A careful analysis of milling a large machine-tool casting (Fig. 7) results in some interesting conclusions. First, analysis of the component reveals the possibility of its withstanding a metal-removal rate of 50 cu. in. per min.—an evaluation based necessarily on experience. With the customary K-factor of 0.5 for this cast material (30,000 psi.), horsepower required would be approximately 25. As the horizontal boring and drilling machine is equipped with a 15-hp. motor, this rate of removal must necessarily be restricted.

An analysis of the workpiece and spindle position when the upper faces are being milled exposes limitations in this operation. Spindle position, as shown, results in excessive vibration in both column and component when milling the upper portions. The cutting forces acting through a lever arm of approximately 50 in. result in a sufficiently large couple to cause damaging effects.

Vibration Affects Accuracy

Moreover, specifications call for close tolerances in both dimensional accuracy and surface condition, these two being closely related in this operation. Vibration and distortion in machine members, as well as in the component, must therefore be avoided.

Because of these circumstances, this operation was performed at a feed rate of 15 ipm. As an 8-in. dia. cutter is being used, a 5-in. wide swath is cut per pass. The necessary depth of cut is 0.200 in. for cleaning up the surface specified for machining.

Thus not more than 15 cu. in. is being removed per minute. By checking on the other operating characteristics, it is found that tooth load is 0.013 in., still quite satisfactory. The surface rate with a spindle speed of 150 rpm. is 315 sfpm., good practice in carbide milling of cast iron.

Metal-removal rate for this operation must not exceed 15 cu. in. per min. because of the unfavorable relationship of spindle to workpiece and machine table. Any higher rate results in inadequate finishes and tolerances in spite of the relatively low power consumption of 7 hp. Thus slightly less than 50% of the available power in the equipment is utilized.

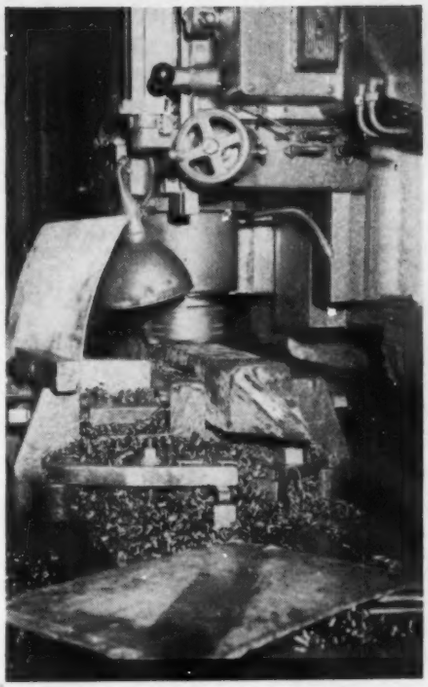


Fig. 8—SAE 1020 billet, 8x8 in., is milled with a 12-in. step cutter used as a face mill with all blades set in the same circle and to the same depth

Better Cutter Position

To gain more economical metal removal by using machine-tool equipment more efficiently, this operation should be scheduled on a planer-type machine, which would permit a far more favorable relationship between cutter and workpiece.

In spite of these disadvantages, the greater economy of carbide over

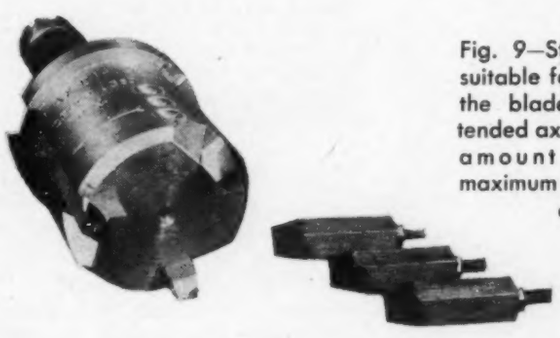


Fig. 9—Step cutters are suitable for deep cuts, as the blades can be extended axially the desired amount and provide maximum chip accommodation

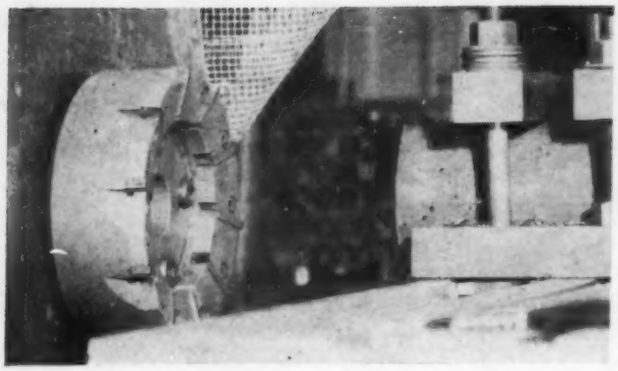


Fig. 10 — Depth of cut is limited with face mills, because of slight axial depth of blades and minimum chip accommodation space between blades

traditional cutting materials is immediately evident. With a high-speed steel mill the feed rate was 6 ipm. and the metal-removal rate restricted therefore to 6 cu. in. per min. Once again, less than 25% of the available power was utilized, as compared to 50% when applying carbide, while the metal-removal rate is reduced by 60%. Floor-to-floor time for this job is reduced by 50% with application of carbide.

Truing up of an 8×8-in. SAE 1020 steel billet (Fig. 8) presents an interesting problem. It is immediately obvious that no limitations are present in the workpiece itself or in holding it against all vibration and distortion. The sole problem consists in equating the power available in the machine tool to the metal-removal rate that such power makes possible. Not even tolerance or finish limitations enter into scheduling of this job.

Step Cutter Chosen

As the face to be milled is 8 in. wide, a 12-in. dia. cutter having 8 blades is chosen. While this cutter is of the step design, it is set for this operation as a face mill, that is, all blades are set in the same circle and to the same depth or extension on the face.

Such a cutter is shown in Fig. 9, but of a different diameter. But the design is the same, and it is ideal for such a job as a heavy depth of cut can be taken by extending the blades the desired amount.

A cut 0.650 in. deep is needed to effect a truing pass. Taking this cut is impossible with the conventional face mill with blades set radially (Fig. 10), as the depth is limited to the depth of the carbide blade measured axially. As these blades are 5/16 × 9/16 × 2½ in., it is impossible to take a cut deeper than 0.500 in. because the projected distance, after grinding the face angle, is always less than 9/16 in. In fact, it would be inadvisable to attempt a depth of pass greater than 0.450 in.

Moreover, the step design permits heavy cuts at large tooth loads without any sign of chip interference, whereas the conventional face mill has a minimum chip-accommodation space inherent in its design. Any radial-set bladed cutter has this disadvantage, but it is not implied that the radial design has no advantages. The reason for its almost universal adoption is the preponderance of advantages over disadvantages.

A third reason for selection of the step-design cutter is an economic one. This roughing operation would not justify a $250 cutter of 12-in. dia. with 12 solid-carbide blades costing about $60. If an accident occurred or if the machine stalled in the cut, much valuable carbide would be ruined.

By using a cutter that costs half as much with standard brazed tip blades costing only one-fourth as much as solid-carbide blades, there exists a better economical relationship between nature of the job, its value and importance, and the cost of tooling with which it is accomplished.

Power Only Limitation

As no limitations exist in the workpiece and its holdability, the power available at the spindle of the designated machine determines metal-removal rate. The machine chosen for the job has 30 hp. available at the spindle. As the K-factor of the steel is safely taken as 0.5, 60 cu. in. per min. can be removed with the power available.

Other operating characteristics are easily determined. As depth of cut is set at 0.650 in. and face width of the surface to be milled is 8 in., the sectional area of cut is 5.2 sq. in. The feed rate then is 60 ÷ 5.2 = 11.5 ipm.

As always, it is good practice to check tooth load and other essentials of the setup, such as the surface rate. With a feed of 11.5 ipm., 8 blades in the face mill and a spindle speed of 150 rpm., tooth load is 11.5 ÷ (8 × 150) = 0.010 in. While this is on the borderline of good practice, it is the best that can be effected under the circumstances.

This is all the more evident when other operating features of this setup are closely examined. The choice of 150-rpm. spindle speed is dictated by the following considerations: At this speed the surface rate with a 12-in. cutter is 468 sfpm. This is low, as material such as specified in this billet calls for a surface speed of around 600 sfpm. But consideration is given to the scaly, dirty nature and character of the billet, or at least its surface, so the surface foot rate is held down to a trifle under 500 sfpm.

At this speed, the abrasive action of the scale and dirt will do less harm than at a higher speed. Moreover, the tooth load, had a higher surface rate been selected, would have been undesirable.

Milling Steel Block

The rating of a job consisting in face-milling all sides of a steel block for a large valve is another example of converting horsepower at the spindle into cubic inches per minute of metal removal.

The milling machine is a standard No. 4 with a 15-hp. motor for spindle and table drive. The component is an SAE 1020 composition with a K-factor of 0.5. The rate of metal removal, determined by converting the power at the spindle into cubic inches per minute, is 30. There is no need to delay with considerations of the workpiece, its setup or its tolerance specifications. The latter constitute no limitation whatsoever on the metal-removal rate.

The face width is 5 in., so an 8-in. cutter having 8 blades is selected. Surface rate, based on a spindle speed of 300 rpm., is slightly over 600 sfpm. Depth of cut is 0.175 in., making the cross-sectional area 0.875 sq. in. Feed rate therefore is 30 ÷ 0.875 = 34.3 ipm., with the nearest feed rate on the dial being 35 ipm. Under these conditions, tooth load is 35 ÷ (8 × 300) = 0.014 in., which represents good practice.

Case Studies—10-Step Setup Procedure

THE TEN-STEP procedure for setting up carbide-milling operations is not only logical; it works. It has been tried and tested in actual shop setups, production lines and planning departments.

If this method of analysis and production planning is adopted, it will go far to relieve the headaches and obviate the difficulties encountered in conversion to carbide milling.

The ten-step procedure has been formulated in previous pages and amplified by special attention to the metal-removal rate. To exemplify the procedure in its application to practical milling jobs, operations will be presented in the order of the ten classes of materials that serve as the basis for specifying surface speeds. These operations are actual shop jobs that have been analyzed by this procedure and run successfully under usual shop conditions.

WROUGHT IRON

A WROUGHT-IRON block (Fig. 11) is being milled with a 6-in. axial type of cutter with four blades. Milling of this block, intended as part of a large electric motor, will be analyzed in accordance with the ten steps in their proper order.

Identify Material

Identifying the material in the workpiece is the first and most important step for success in carbide milling. This workpiece could easily be classified as steel and an attempt made, unsuccessfully, to mill it according to steel standards.

Wrought iron must be treated as a special ferrous material in classifying it. The surface rate is entirely different from that specified for all other ferrous materials, except stainless steel.

The Brinell hardness number does not identify wrought iron other than a soft, in fact dead-soft, steel. The Brinell hardness is well below 140 as determined by portable testing equipment. So its true classification must be determined otherwise.

Only the specification sheet that establishes its carbon content as below 5 points is satisfactory for this purpose. When working in the range of low-carbon steels, it is advisable, almost imperative, to have available a chemical analysis.

Select Surface Rate

As soon as the material has been definitely and surely identified, the surface rate can be specified. As this workpiece is wrought iron with a carbon content of less than 5 points, surface speed of the cutter should be specified as not less than 1,000 sfpm.

The 6-in. dia. cutter is therefore mounted on a spindle to revolve at a speed as close to 641 rpm. as is available on the dial.

Spindle speed is determined by dividing surface rate by the circumference of the cutter in feet, or $1000 \div (6 \times 3.1416 \div 12) = 641$ rpm. As $3.1416 \div 12 = 0.2618$, use of the constant 0.26 saves time in these calculations.

The only modification usually necessary is selection of the surface rate on the basis of the rate available on the dial nearest to the specified rate. It is generally considered better practice to choose the lower rate, but in milling wrought iron the higher rate should be selected.

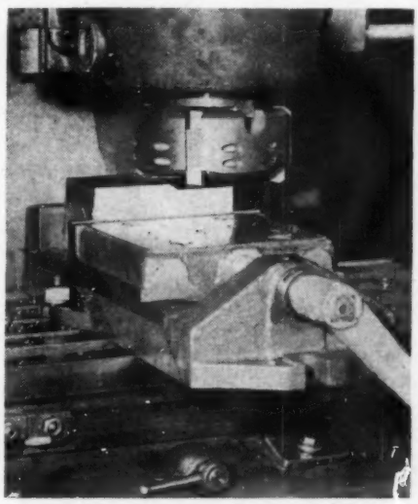


Fig. 11 — Wrought iron demands at least 1,000-sfpm. cutting speed and a cutter with 10° positive radial rake, 7° negative axial rake and 15° face relief. This solid block can stand a metal-removal rate as high as 150 cu. in. per min. and 75-ipm. feed with a 2-sq. in. area of cut

Wrought iron is so critical, from the standpoint of surface rate in the higher ranges, that 1,000 sfpm. should be considered as the lowest rate. The dial reading selected therefore is 675 rpm., the next highest above the specified rate. This changes the actual surface rate to 1,053 sfpm., determined by reversing the formula.

Determination of the surface rate for this wrought-iron job, although apparently time-consuming, actually saves time because of the critical nature of this factor.

Select Cutter and Diameter

Selection of the proper cutter is the second critical factor in the milling of wrought iron. Without selection of proper cutting and clearance angles, the job of milling wrought iron will fail.

As the workpiece is 4 in. wide, a 6-in. dia. cutter is specified. The axial type was chosen when the actual job was set up, because one was available and this type is satisfactory where cutting pressures are not exceptionally high. The shanks with brazed carbide tips are held in place with setscrews and have not the same holding power against heavy cutting pressures as do other designs.

Moreover, this is a step-mill design in which blade slots are milled to varying depths. When used as a step mill, the blades are set at varying depths. But the same cutter, as shown here, can be used as a face mill; that is, all blades are set in the same circle and to the same depth.

The radial rake angle is specified at 10° positive. The axial angle is 7° negative with a resulting true rake angle of approximately 8° positive when the nose angle is 15°. The clearance angle on the periphery, instead of being divided into two angles—relief and clearance, is recommended as one angle of 7°.

The face relief angle, ground to the cutting edge without land, is 15°. This specification is imperative as it is definitely a critical angle. The face cutting edge, or dish angle, is

0°. The length of the zero line must be slightly greater than the feed per revolution to eliminate feed marks. If this recommendation is followed, finish obtained will be superior to those resulting from the customary technique.

Metal-removal Rate

The motor component by its nature, design, construction and holdability justifies a high metal-removal rate. It measures $4 \times 4 \times 10$ in., is solid and is easily held in a vise. It is possible with a job of this nature to remove, according to experience, 150 cu. in. per min.

Correlate Rate with Power

For all practical purposes the only limiting feature in an operation of this kind is the power available in the machine. Fortunately this is a 50-hp. milling machine designed for carbide milling.

It has a built-in flywheel, electrical braking system and separate table feed drive. Metal-removal rate therefore can be set tentatively at the 150 cu. in. per min. feasible according to workpiece characteristics.

Established Feed Rate

As the width of cut is 4 in. and the depth is 0.500 in., the sectional area is 2 sq. in. This means that with a metal-removal rate of 150 cu. in. per min. feed rate will be 75 ipm. This rate is available in this equipment, which has a top feed of 90 ipm.

Check Tooth Load

The tooth, or chip, load is found by dividing the feed rate (75 ipm.) by the number of teeth (4) multiplied by the spindle speed (675 rpm.). This equals 0.028 in., which not only is not excessive but actually is advantageous.

It is well also at this point to check the horsepower consumed: $4 \times 0.500 \times 75 \times 0.3 = 45$ hp. The K-factor of 0.3 is somewhat low and the 50-hp. machine may be considered as fully loaded.

Specify Milling Method

Milling method refers to the choice between climb and conventional. In a horizontal machine or with the cutter on an arbor, the method can be referred to as either climb or conventional, but it does not apply strictly to this type of face-milling job.

Nevertheless, this step is worth considering from another point: positioning of the cutter with respect to the workpiece is important; that is, the center line of the cutter should be offset from the center line of the workpiece (Fig. 12).

This means that the chips formed at the beginning of the cut will have a maximum thickness, which is of advantage in carbide milling as the thicker the chip the less will be the friction and abrasion directed against the carbide blades. The recommendation to set the cutter "on the bias" deserves faithful compliance.

Cutter Care and Grinding

The mechanics of routing the cutter from the machine to the toolroom with specifications for grinding set forth on a tag is in line with similar procedures commonly practiced. This motor-component operation is scheduled in large job lots, so the number of blades that should be ground and kept in reserve depends on cutter life and frequency of removal.

Cutter life is 15,000 sq. in. of metal removed between grinds. As there are 640 sq. in. on four sides of the workpiece, approximately 25 of these components can be milled on all four sides as specified between grinds.

What is the total time for 25 pieces? Cutting time is 8 sec., return time 4 sec., cycle time 12 sec., change position time 60 sec., total time for one side to one side 72 sec., In milling flat and parallel sides as and total floor-to-floor time 288 sec., or 4.8 min. Time for 25 pieces is approximately 2 hr.

Because of safety, four changes in an 8-hr. period should be considered. This means that 16 blades will be used each working period of 8 hr., so at least 32 blades will then necessarily be ground and allocated to this job, or more if the load on tool grinding is too great to recondition 16 of these shanks every working period.

As this condition usually exists, the number of blades should be specified as 48. This number should be ample as the shank or blade can be easily and quickly ground offhand on a pedestal grinder. A green wheel may be specified for this operation although a diamond wheel is preferred, either being used with coolant.

Surface and Tolerance

Surface and tolerance specifications can be disregarded as surface condition specified as "commercial" is required. While wrought iron does not yield a good finish, being too stringy and soft, obtaining a commercial finish is within reasonable attainment.

The accuracy demanded is not excessive, 0.010 in. for parallelism. As pieces are short, tilting of the table on this knee-type machine is not a factor. Actually the sides of this motor component were milled to an average of 0.003-in. tolerance for parallelism.

This same operation was subsequently performed with excellent results by using a magnetic chuck. The chuck, embodying a new principle and produced by the Rockford Magnetic Products Co., is applicable to milling operations involving unusually high cutting pressures.

The total time was reduced from 4.8 min. to 2.8 min. per piece. The saving was effected in the handling time and the time for changing the piece from one side to the opposite. here, one side is milled; then its opposite is milled, using the first side for locating. The fixture designed for this operation is simple: a flat plate, in effect a surface plate, with a well for the chuck and holes suitably spaced and used for end and side stops.

The operation on the electric-motor component, which would otherwise be impossible using the traditional methods with high-speed steel, is shown to have a high de-

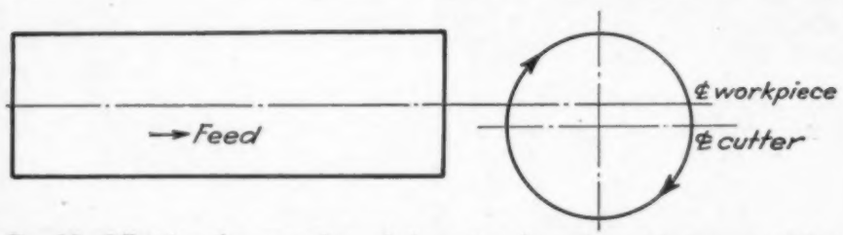


Fig. 12—Offsetting the centerline of the cutter from the workpiece centerline forms thickest chips at beginning of cut, which reduces friction and abrasion on carbide blades. Setting cutter "on the bias" is strongly recommended

gree of machinability. The cutting time is remarkable: the over-all time of 4.8 min. with a vise is unusual and of 2.8 min. with a magnetic chuck is wholly revolutionary.

LOW-CARBON STEEL

THE FOLLOWING discussion deals with two milling operations on low-carbon-steel components (Figs. 13 and 14). The first is a piece of boiler plate with about 10 points of carbon, and the second is a low-carbon steel having 8 points of carbon. Both components will be considered together to illustrate the approach to a successful milling job on this rather ornery class of material.

There are critical factors in the milling of such components. Unless they are recognized and heeded, failure is the end point. The approach to these jobs will be made systematically, according to the ten listed steps.

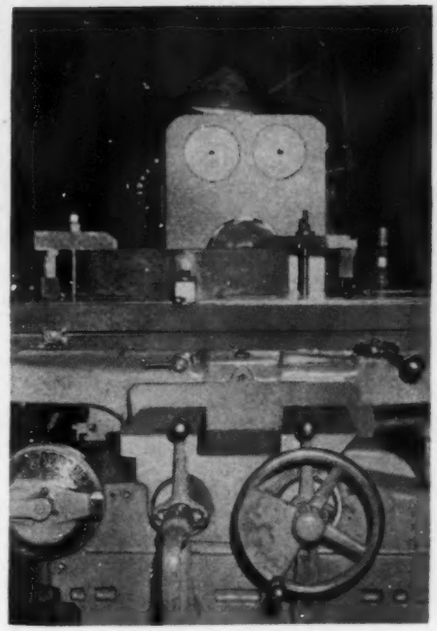


Fig. 13 — Low-carbon steel must be identified from carbon content to select the surface rate, 700 sfpm. for this valve component. Holdability by clamping is good, but slow compared to use of fixture or magnetic chuck

Identify Material

This again is the first and most important step to be made. Again also, determination of the Brinell hardness number, whether with approximate portable equipment or accurate laboratory instruments, is not sufficient. The low Brinell reading, from 135 to 140, will not serve as a basis of procedure.

The low Brinell in both workpieces is the result of the low carbon content, but the carbon content of this boiler plate is also responsible for other characteristics, such as a low rate of machinability. This may not be true of other steels that have Brinells of the same general range but differ in metallurgical and other characteristics.

Analyzing these materials for a successful carbide-milling setup demands full and complete information. Chemical analysis is important: when it shows a carbon content of approximately 8 points, it indicates the problem to be encountered.

Select Surface Rate

The surface rate to be specified ranges from 600 to 900 sfpm. for this class of material. As these components are of low-carbon range, a rate of 700 sfpm. is specified. Exact specification of a rate is not important; in fact, it is frequently a waste of time to attempt to do so.

Time should not be wasted in an anxious endeavor to establish exactly—as though that can be done—the proper surface rate. What is actually the proper rate apparently lies somewhere between two limits that are not always close together.

Select Cutter and Diameter

The over-all width to be milled in Fig. 13 is 4 in. and in Fig. 14 is 5 in., so an 8-in. dia. cutter is specified. The exact diameter again is not a matter of mathematical accuracy and determination, common practice being to use a ratio of 5 to 3 or 8 to 5.

Obviously, in selecting a diameter for the job in Fig. 13, a 6-in. cutter would have complied more closely to the usual ratio. But a 6-in. cutter is held in place with a draw-in rod or it is mounted on and by its integral shank. Also, in the first method a C-type arbor is necessarily used. Both mounting methods are probably not as effective as using a center plug for an 8-in. cutter and mounting it directly on the spindle nose by using four spindle nose bolts to fasten it securely to the spindle. This mounting is certainly rigid and in a grueling operation, such as is indicated in these job lots of considerable size, is preferable.

The angles, both cutting and clearance, are most important; one of these, the face clearance angle, is truly critical. Unless the recommendation proper to these low-carbon materials is followed, failure will inevitably follow.

The following cutting angles are recommended:

7° negative radial rake
7° negative axial rake
15° nose angle
7° negative true rake
0° face cutting edge angle
15° face relief angle (critical)

or 10° positive radial rake
7° negative axial rake
15° nose angle
8° positive true rake
0° face cutting edge angle
15° face relief angle

When the cut is interrupted as in Fig. 14 and the equipment does not have a built-in flywheel, the negative cutting angle is preferred. The power required is not increased, and if the radial rake land, or "K-land," is held to narrow limits, the results are entirely satisfactory.

Radial rake land should never be more than 1½ times tooth load. For all practical purposes, this is approximately 0.030 in. In milling, the chip is compressed and thickened during the cutting cycle. This is estimated, although it varies with different materials, at 50% increase over normal thickness.

The negative cutting angles were chosen for these operations, although under other machine-tool conditions and a somewhat more favorable workpiece design the positive cutting angles could be used. In fact, all materials below 160 Brinell hardness number can be milled with positive angles, provided all other conditions are optimum.

Metal-removal Rate

The work in Fig. 13 is a solid piece of boiler plate, intended for a large valve mechanism. It can withstand a high metal-removal rate without distortion and vibration. Its holdability is good. It is clamped to the table which, from the viewpoint of holding alone, is excellent. From the viewpoint of time, this method leaves much to be desired.

Mechanically operated fixtures are not justified as the job lot size is seldom greater than 100. This piece, however, can be held with a recently designed magnetic chuck that effects with 6 v. a tremendous hold-

ing force capable of application to jobs of this kind. It is impossible to capitalize on the remarkable reduction in cutting time effected with carbide unless the handling time is proportionately reduced and the cutting and handling cycles are brought into reasonable relationship with each other.

With a magnetic chuck and stops, both suitably mounted on a flat or a surface plate, the time required to locate the piece and throw the switch is only a fraction of that required with a table setup as shown. But metal-removal rate should be limited to 100 cu. in. per min.

The piece in Fig. 14, part of a switchgear arrangement, is also clamped to the table and the time for handling is again out of proportion to the reduced cutting time. The magnetic-chuck arrangement would reduce the handling time, but caution is required when specifying the metal-removal rate for table clamping as compared with magnetic-chuck holding.

For the former, a rate of 75 cu. in. per min. is suitable. The interruptions cause decided vibration shocks that will either lower the finish below what is specified or reduce cutter life so it is not economical to operate above this rate.

If the same piece is held in a magnetic-chucking fixture, the rate should be still further reduced to about 60 cu. in. per min. These rates are based on experience largely, although some experimental work has been carried on to establish a basis for them.

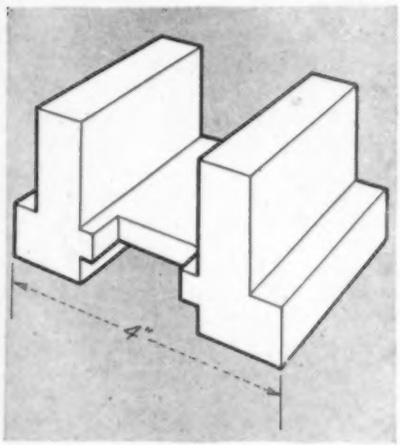


Fig. 14 — Wrought-iron, switchgear component presents an interrupted cut for which recommended cutting angles are 7° negative radial rake, 7° negative axial rake, 15° nose angle, resulting in 7° negative true rake

Correlate Rate with Power

The first question is, "How much power is available in the machine designated for this operation?" The No. 4 plain miller being used is a standard 15-hp. machine without the features now being designed into machines used for carbide milling exclusively. This refers to the built-in flywheel, the electrical braking system and the separate table drive, among other important items considered and proved necessary for successful milling with sintered carbides.

Equipment of this kind has a gross power factor of 0.5; that is, ½ hp. is required to mill 1 cu. in. per min. Hence 30 cu. in. can be safely removed each minute. The removal rates established in terms of the workpiece and its holdability must therefore now be discarded and a rate of 30 cu. in. per min. established.

Establish Feed Rate

The piece in Fig. 13 is 4 in. across the face to be milled and the depth of cut specified by the blueprint is 0.200 in., making the sectional area 0.8 sq. in. If the removal rate is 30 cu. in. per min., the feed rate is $30 \div 0.8 = 37.5$ ipm.

The piece in Fig. 14 is 5 in. across the faces to be milled and the depth of cut is 0.125 in., making the sectional area 0.625 sq. in. The width of the cut is considered as 5 in. as, at some point in the travel of the cutter and for a few seconds or more, the cutting teeth will be in a full 5-in. wide cut. At least that seems likely from an examination of the piece and matching of an 8-in. dia. cutter against its face. At any rate, it is safer to assume this to be true.

With a removal rate of 30 cu. in. per min., the feed rate becomes $30 \div 0.625 = 48$ ipm. The nearest dial reading for operation (Fig. 13) is 35 ipm., and for operation (Fig. 14) 40 ipm. The latter is low, but the next higher is 50 ipm. As 48 ipm. is considered, on the basis of experience, too high for such an interrupted cut, the lower rate is selected.

Check Tooth Load

Checking the tooth load for operation (Fig. 13) results in the following determinations:

Surface rate = 700 sfpm.
Spindle speed = 336 rpm.
Feed rate = 35 ipm.
Tooth load = 0.012 in. (good)

For operation (Fig. 14):

Surface rate = 700 sfpm.
Spindle speed = 336 rpm.
Feed rate = 40 ipm.
Tooth load = 0.015 (good)

As this method of approaching a carbide-milling job checks on the tooth load last (beginning with the surface rate as established by the material and using the horsepower available or allowed by the workpiece), the tooth load is permitted to fall where it may. If the load is unreasonably large, a compromise must be effected with either width or depth of cut which in turn would alter the feed rate.

Cutters for carbide milling of steel are usually equipped as manufactured with a number of teeth equal either to the diameter in inches or to the diameter in inches plus two.

Cutters for these operations belong to the former class. In some analyses, the number of teeth, for an optimum tooth load, is either too few or too many. Simple compromises can be made to bring the operating characteristics into line with good practice.

But to calculate the number of teeth required for a certain setup is contrary to good economics. This would require a specially designed cutter for almost every operation, and any tool specially designed is twice or more the cost of a standard one. The approach here recommended and tested over innumerable carbide-milling operations will therefore save the production personnel grief, time and useless expense.

Specify Milling Method

The method of milling in these operations is neither climb nor conventional, strictly speaking. If the cutter is offset as shown in Fig. 12, the cut will be predominantly climb.

Cutting forces will be directed against the direction of workpiece feed (conventional) in milling the first half of the workpiece face, but they will be directed in the same direction as the feed in the last half. As offsetting the cutter makes the latter larger than the former, the cut may be referred to as predominantly climb.

Of greater importance are these considerations: (1) Offsetting the cutter provides greater chip thickness at the beginning of the cut and less friction and abrasion on the carbide blades. (2) When the cutter is directed as in Fig. 13, the cutting forces are downward and against the milling table. This is preferable to an upward direction counteracted

only by two clamps and air—largely the latter.

Cutter Care and Grinding

Both operations are performed with solid carbide blades mechanically held. When dull, they are removed and ground in a fixture (Fig. 15). They may be removed, leaving the body on the spindle and replacing the dull blades with freshly ground ones. Or they may be removed integrally with the cutter body, later removed from the body in the toolroom and then ground in a fixture on a small surface grinder. A 2½-in. blade may be reground about 100 times.

Replacing the cutter body (and blades) with another body properly equipped with fresh ground blades requires about 10 min. Removing and replacing blades on the body while it is on the spindle requires approximately 20 min., but has advantages that may offset the disadvantage of longer time.

The advantages are greater accuracy and better finish if blades are set in the cutter body to the shoulder of a flycut made by one blade. This method is the equivalent to the machine creating its own gage for the setting of blades; that is, any runout in the spindle or inaccuracy in the bearings will be registered by the flycut method.

In these operations, the cutter body is removed from the machine with the blades intact and replaced by a fully reconditioned mill. The downtime is about 10 min. Cutter life, however, is such that no change in cutters is necessary before 12 hr. for operation (Fig. 13) and 8 hr. for operation (Fig. 14). Here the effect of the interrupted cut is immediately noticeable on cutter life reducing it by 50%, although techniques and kind of material milled are similar.

Surface and Tolerance

This step need not delay the analysis. In both specifications, surface finish and accuracy are well within the possibilities of this type of operation. This is proved by checking the first milled piece and every 25th subsequent piece.

Floor-to-floor time for operation (Fig. 13) on the valve component is 1½ min. and for operation (Fig. 14) on a switchgear part is 1¼ min. Moreover, with an improvement in the handling and clamping of these pieces, particularly by application of magnetic chucks, the time can be reduced by an additional 25%.

The older techniques and cutting materials would not only not approach this floor-to-floor time, but the operation is also practically in the impossible class. The effect of low-carbon steels on high-speed-steel mills is the same as if the materials were rated as non-machinable. Cutter life is abominable and the downtime on the machine is excessive.

STAINLESS STEEL

THE STAINLESS-STEEL (type 304) component (Fig. 16) contains no sulphur and would generally be classed therefore as non-machinable or at least with low machinability. Until the advent of carbide milling, stainless 304 was considered as strictly non-machinable with multi-toothed cutters as in milling.

The carbide milling technique that has successfully subdued this difficult, and yet highly useful, engineering material will be discussed, using the ten-step approach to setting up of milling operations.

Identify Material

In taking the first step to production planning of a carbide-milling job, it is assumed, and such assumption is generally true, that a stainless steel of type 304 is unmistakably marked. All other stainless steels can be milled with the same technique that can be effectively applied to standard steels.

Select Surface Rate

Experiments and experience show a surface rate of 900 sfpm. for this material is satisfactory. This selection and specification applies, however, only to type 304 stainless without sulphur. For all other stainless materials, the surface rates recommended for standard steels are used.

Select Cutter and Diameter

The third step in the analysis is the cutter specification as regards to diameter, cutting and clearance angles, grade of carbide used, etc.

As the billet, the end of which is to be milled, is 5 in. square, an 8-in. dia. cutter is selected by using the accepted ratio of cutter diameter to workpiece width as approximately 8 to 5.

The cutting angles specified for this material are as follows: 10° positive radial rake, which with a 7° negative axial rake and a 15° nose angle results in an 8° positive true rake angle. This combination is the same used for milling cast iron, wrought iron, and low-carbon steel.

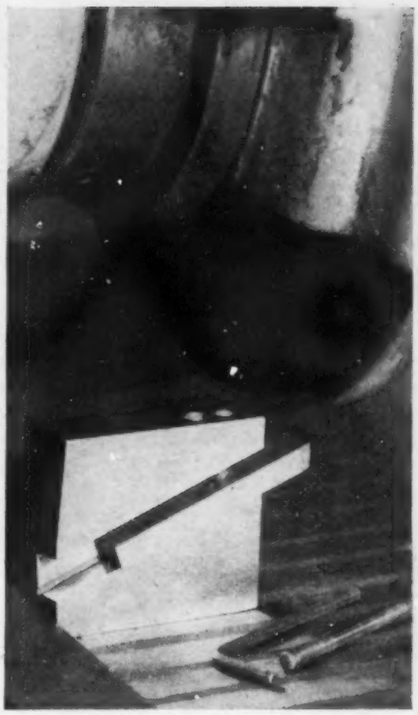


Fig. 15. — Solid carbide blades are ground in fixtures on surface grinders. Grinding time is about 1½ min. per blade with a 200-grit diamond wheel

The positive radial rake angle of 10° is changed to a negative radial rake of 7° when the workpiece or the machine-tool condition affects the positive cutting angles disadvantageously, such as when the former presents an interrupted cut to the cutter or the latter is not ideally suited for carbide milling. Cutting angles are not critical, as they can be changed even from positive to negative without much, if any, change in machinability.

The machine being used has been designed for carbide and has an integral flywheel, electrical braking and separate table drive. The cutting angles are therefore specified with positive radial rake.

The following specification, however, is most important: a 15° face relief angle is critical and must be closely observed in grinding. It is ground to the face cutting edge without leaving a land. The face cutting edge angle is specified as 0°.

Fig. 16 — Stainless steel (type 304) can be milled at 900 sfpm. and with a positive radial rake under good conditions. At top feed of 60 ipm. with 8-in., 8-tooth cutter, the tooth load is about 0.017 in., which is considered good practice

The grade of carbide is of steel-cutting variety characterized by great slipperiness or ease of ridding itself of the chip without damage, particularly to the binder. Carbide manufacturers' recommendations should be faithfully adhered to in this specification.

Metal-removal Rate

The metal-removal rate justified by this workpiece, a solid billet which can be readily clamped to the machine table, is in the top brackets. There is no reason to place a limit on the rate because of any feature of the workpiece or its ability to be held securely and rigidly. Moreover, it has been milled at rates as high as 100 cubic in. per min. with 50 hp. available.

Correlate Rate with Power

The horizontal, knee-type machine selected for trimming of this stainless billet has a total of 55 hp. available under normal full-load rating. As evident from analysis of the metal-removal rate, all this power can be utilized to remove metal.

Establish Feed Rate

Billet dimensions are 5 x 5 in. and the depth of cut to clean up the end is 0.250 in., making the sectional area of cut equal to 1¼ sq. in. The feed rate will then be 80 ipm. at a removal rate of 100 cu. in. per min.

As this milling machine has a top feed rate of 60 ipm., it will be necessary to restrict the table feed. So the operation is specified at 60 ipm. or at a removal rate of 75 cu. in. per min. This is also based on the further assumption that the K-factor of this material is 0.5. As this is approximately correct, these specifications can be considered as established, provided only that checking the tooth load produces satisfactory results.

Check Tooth Load

At 900 sfpm., the spindle speed for an 8-in. dia. cutter must be 430 rpm. The nearest speed given on the dial is 424, so the actual surface rate is 890.4 sfpm.

With a feed rate of 60 ipm., the tooth load is slightly over 0.017 in. This is good practice according to every expert in carbide milling.

Specify Milling Method

If the cutter is positioned with respect to the workpiece as indicated in Fig. 16, that is, with its center line higher than the center line of the workpiece, the cutting pressures are downward against the milling-machine table.

If the center line of the cutter is set as close to the top edge of the workpiece as possible and still clear the bottom edge, the tooth enters almost at right angles and chip thickness at the beginning of the cut is thicker than it would be otherwise.

Cutter Care and Grinding

In this operation, dull blades are removed from the cutter body, leaving it on the machine spindle. A freshly ground set of blades is then inserted by taking a fly cut with one blade set in place and setting all blades, on the O.D., to the shoulder of this cut. Thus all run-out is eliminated and the most accurate setup of machine and cutter is available.

Replacement of a set of blades requires approximately 20 min. in an 8-in. dia. cutter. This is somewhat longer than is required to remove a cutter body and replace it with another. Yet the advantages of blade replacement are considerable as experience testifies.

Surface and Tolerance

The specifications for surface condition and accuracy are of no consideration in this operation, which calls only for the "skinning" of a billet of stainless steel. Both finish and accuracy are of secondary importance. Yet, stainless steel, such as this billet, finishes satisfactorily, provided the technique of using a zero face cutting edge angle and a length on the face cutting edge equal to the feed per revolution is employed.

STANDARD STEEL

AN AIRPLANE wing hinge is the workpiece selected for consideration of its milling operation under the classification of standard steels. This is an SAE 4340 steel which, prior to heat-treatment, registers a 230 Brinell hardness number. The information as to the SAE number is contained in the information passed on to the shop, while the Brinell hardness is tested to check the specifications.

Variation in the Brinell number ranges between 220 to 235. It seems safe to take, therefore, an average hardness of 230. This will serve to identify and classify this steel component—an airplane wing hinge that is scheduled to be duplex-milled (Fig. 17). After duplex-milling of the two sides, a slot is milled in the forging and other operations, such as drilling, are performed.

Select Surface Rate

The surface rate is specified at approximately 525 sfpm. (Table I) on the basis of hardness in standard steels. "Standard" steel is not a technically correct term and is not therefore wholly acceptable to the metallurgist. But it is here used to mean a steel that is analyzed for milling by beginning with its hardness, from which is determined the surface rate of the milling operation.

All other steels have a surface rate specified on some other basis as do the low-carbon, stainless and other steels; that is, the standard method of determining the surface rate of milling steel is the use of the Brinell number, but where steels are not "regular" in this sense, information other than the hardness must be considered.

As the spindle speed, with a surface rate of 525 sfpm. and an 8-in. cutter, is 252 rpm. and the nearest dial reading is 260 rpm., the surface rate changes unappreciably.

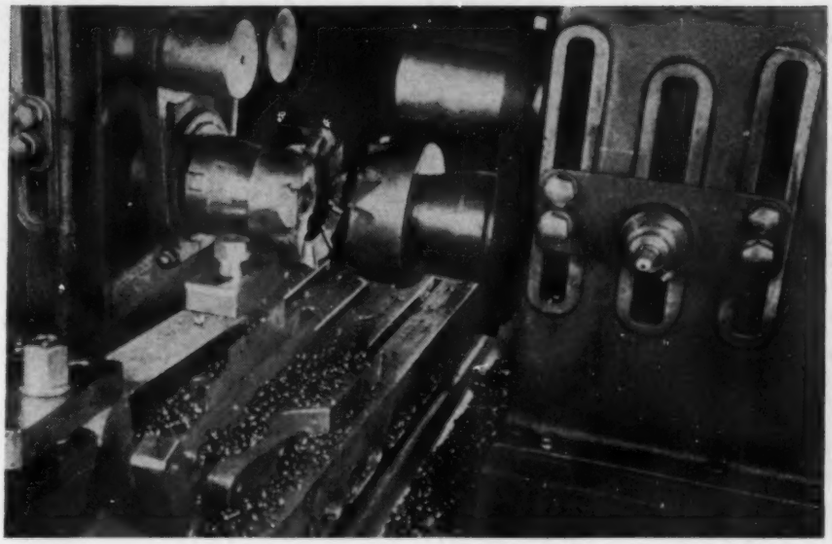


Fig. 17—This steel, airplane wing hinge of 230 Brinell is duplex-milled with 8-in., 10-tooth cutters to reduce downtime. Use of 4-in. cutters with 6 blades would mean 40% less cutter life and only 80 hinges, instead of 125 between grinds. Time saved compensates for longer table travel

Select Cutter and Diameter

Cutters 8 in. in dia. are selected for this operation and for an interesting reason. On the basis of workpiece size, a much smaller diameter could well be applied. But the steel is tough and the duplex setup requires considerable time to make. Downtime on this machine for this operation will therefore be considerable.

Downtime to replace cutters will require proportionately more time than for a single-spindle operation. Hence 8-in. dia. cutters, each having 10 blades, are selected in order to present more carbide to the operation and obtain a longer run between grinds and less downtime on the machine.

If a 4-in. cutter with 6 blades had been selected, cutter life would have been 40% less as there is 40% less carbide. Approximately 125 of these forgings are duplex-milled with 8-in. cutters between grinds. About 80 would have been completed with 4-in. cutters.

The advantage of using the larger cutter, in spite of the longer table travel required—approximately 12 plus 8 or 20 in. instead of 12 plus 4 or 16 in., is apparent when it is realized that the time required to remove the cutters, replace them with freshly ground cutters and reestablish the correct dimensional relationship between cutters and hinge forging is approximately 45 min. Reestablishment of the correct dimensional relationship between cutters and wing hinge requires considerable time.

Metal-removing Rate

The wing hinge is approximately 14 in. long, 4 in. wide and 1 in. thick on the thin end, tapering to 2 in. on the thick end. This obviously is a solid chunk of metal that can withstand heavy cutting forces without distortion or vibration.

The top metal-removal rate can be applied to this piece as far as its design and construction are concerned. Also it can be held securely and simply. Limitations in metal removal, if any, must come from a factor other than the workpiece or its holdability.

Correlate Rate with Power

An examination of the equipment selected or designated for this operation immediately discloses the limitations imposed on this operation. The power available here is 10 hp., and as with this workpiece and machine the K-factor is conservatively estimated to be 1, not more than 10 cu. in. of metal can be removed each minute.

Establish Feed Rate

The 8-in. cutters have 10 blades, and the spindle is to revolve at 260 rpm. The average width of the cut is 1½ in. and the depth average is 0.150 in., making the sectional area of cut 0.225 sq. in. As two sides are being milled at one pass, the total area is double the sectional area or 0.450 sq. in. The feed rate then is $10 \div 0.450 = 22$ ipm., with the nearest dial reading being 20 ipm. Use of high-speed-steel cutters would reduce the feed to approximately 4 ipm.

Check Tooth Load

The tooth load is $20 \div (10 \times 260) = 0.008$ in. This is not optimum in tooth load and good practice, but is passable considering the limitations imposed by the machine.

Specify Milling Method

Climb milling is specified so cutting pressures are directed down against the machine table. This is good practice. Conventional milling of this component would constitute bad practice.

Cutter Care and Grinding

There need be no delay with the problem of cutter grinding and conditioning. These 8-in. cutters require grinding in a cutter grinder. The problem of getting them to and from the cutter-grinding department is a simple matter of setting up the proper machinery for this purpose.

But this too must be done, but only after setting a reasonable cutter life, approximately 120 hinges between grinds, and insisting that mills be removed at this point unless something happens to dull or damage cutters prior to that length of run.

Surface and Tolerance

Surface finish on the hinges is excellent at the 0.008-in. tooth loads. SAE 4340 steel, of this hardness, yields an excellent finish naturally. The accuracy is of no concern at this stage, as this operation merely establishes a finish on the sides and an approximate dimension across the width which is not considered too critical.

CAST STEEL

As pointed out previously, each class of material demands different consideration for specification of surface rate. Thus there are four classes of steels or five if wrought iron is included. These divisions are not along metallurgical, chemical or physical lines, except as they refer to machinability demands and characteristics.

A combination of metallurgical, chemical and physical characteristics may so change the machinability of a steel as to place it in a different class. Another set of surface rates, cutting and clearance angles and removal rates must then be set up to obtain reasonable machinability, this being nothing other than reasonable cutter life. Any other yardstick for machinability goes over the head of the harassed shop man and the production personnel.

Cast steel illustrates well that the tag "steel" means nothing in carbide milling unless other characteristics are known in addition to its classification as a ferrous material with carbon content from a few to over 100 points.

The surface condition of cast steel is always sandy and makes it essential to restrict the surface rate of milling to a considerably lower figure than is usual for steel of the same composition and the same Brinell hardness.

Identify Material

The cast-steel beam (Fig. 18), pads of which are to be milled, is a current job in a ship-builder's plant. Unless the component is identified definitely as cast steel, the first and most important step in its milling would be wrong. Any other yardstick would classify it as standard steel, with approximately 30 points of carbon and a Brinell hardness number of about 180, so definite identification is necessary.

Select Surface Rate

If it were standard steel, the proper surface rate, according to Table 1, would be approximately 620 sfpm. But this material should not be milled at any rate higher than 400 sfpm. and preferably lower, about 300 to 350 sfpm. The 400-sfpm. rate is here selected and actually used because of limitations in speeds that can be selected on the milling machine.

Select Cutter and Diameter

The pads to be milled are 6 in. wide, so an 8-in. dia. face mill having solid carbide blades mechanically held is chosen for this job. While an 8 to 5 or similar ratio is recommended in carbide milling to provide proper tooth entrance angle and above all to make it possible to mill at the entrance of the tooth the thickest possible chip, still it is also well to remember that the larger the cutter, the longer must be the over-all travel of the table.

As the beam is 216 in. long, the table must actually travel, with an 8-in. cutter on the spindle, 216 plus 8 or 224 in. If a 10-in. cutter were chosen, the travel would be increased to 226 in.

If the job lot is relatively large, the amount of "dead" time of travel table may add up to an amazingly large figure. But when the workpiece is quite long, the addition of a few more inches in terms of cutter diameter makes little or no difference in the cycle time of the operation.

Selections of cutting and clearance angles and carbide grade remain an important phase of this third step. Table 2 provides the necessary information for proper selection of these angles. The standard steel classification is used for this selection.

Cutting angles will be indicated as 7° negative radial rake, 7° negative axial rake and 15° nose angle, resulting in a 7° negative true rake angle. Clearance angles are: 7° periphery, 0° face cutting edge angle and 7° face relief angle.

Selection of a suitable grade of carbide deserves thought and consideration. Here again the manufacturer's recommendations should be faithfully followed. The carbide grade chosen for this job must have far greater resistance to friction and abrasion than do steel-cutting grades, and yet possess, to a considerable degree at least, the strength of steel-cutting grades.

The requirement for resistance to abrasion and friction is uppermost in this selection, and manufacturers provide such a grade that has characteristics intermediate between the cast-iron and steel-cutting grades.

Metal-removal Rate

The cast-steel beam intended for ship construction is unquestionably capable of taking a heavier cut without distress than the available power in the customary spindles will make possible. The job is being done on a large planer-type milling machine that, unfortunately, has no more than 20 hp. on the spindle.

A machine large enough to take this 18-ft. beam should be powered with not less than a 50-hp. motor, direct connected and not separated from the cutter by long spline shafts or pairs and groups of such spline shafts that are, in turn, connected together by gears.

Milling of components is a serious matter of economical removal of metal. This is one of the few places left where productionists can save money, and the opportunity is now presented them with a new technique built around a sintered cutting material that, introduced as it was almost 20 yr. ago in the United States, should be far better known than it is.

This analysis is not intended as a criticism of the machine selected or available for the operation on such a cast-steel beam, but it is intended as a warning both to machine-tool builders and to users of machine tools that such equipment, while it can be used for a converted operation, will not long be tolerated in an industrial world that is now eager and anxious to get metal-removal jobs on and off machines in one-tenth the time formerly possible.

Correlate Rate with Power

The place to look for limitations in the proposed operation is in the machine. The metal-removal rate on a planer-type miller, when working on cast steel, is 2 cu. in. for each horsepower available at the spindle. Thus, 20 hp. available will move no more than 40 cu. in. per min. This is the limitation, tragic and costly, for this job of making cast-steel chips from a cast-steel beam.

Establish Feed Rate

If the width of cut is 6 in. and the depth ⅜ in., the sectional area is 2.25 sq. in. The feed rate then is

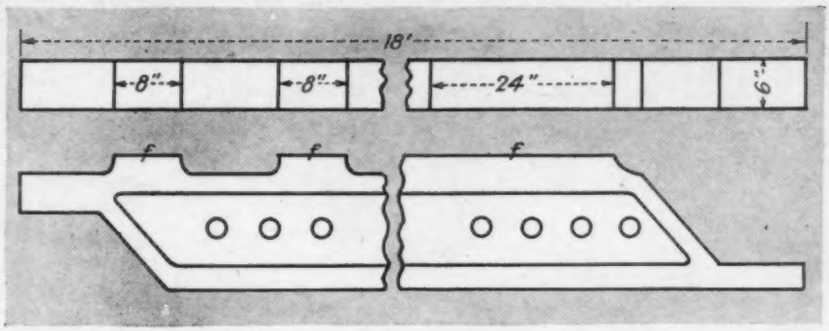


Fig. 18—This cast-steel beam requires a carbide with high friction and abrasion resistance and considerable strength, a grade intermediate between cast-iron and steel grades. Cutting and clearance angles are the some as for "standard" steel

calculated as 40 ÷ 2.25 = 17 ipm.

Actually, the job is being done at a feed rate of 11¼ ipm., first because of irregularities of the surfaces being milled and consequent danger that the machine will be overloaded, and second because this piece of equipment could not be run so close to full load because of its general condition.

Check Tooth Load

The spindle speed for 400 sfpm. with an 8-in. cutter is 190 rpm. At this spindle speed with an 8-in., 8-tooth cutter operating at 17 ipm., the tooth load would be approximately 0.011 in.—only fair practice.

The chip load at 11¼ ipm. is approximately 0.007 in., which is just on the right side of shady practice. At this feed rate, the metal-removal rate is a trifle over 25 cu. in. per min. The K-factor of this machine is close to 0.75, and the power required to remove this small amount of metal is approximately 18. Power requirements were checked with a recording meter to confirm this estimate.

Specify Milling Method

The beams are strapped to the table of the planer-type miller, and the horizontal spindle is used. This is preferable to using the vertical spindle for several reasons, most important of which is that the horizontal spindle receives its power without the dis-service of spline shafts and bevel gears and therefore is more capable of removing metal in line with the possibilities inherent in the cutting material.

Moreover, this method of mounting the workpiece permits running the cutter so cutting forces are directed against the machine-tool table. If the vertical spindle were used, cutting forces would necessarily be directed against some kind of stop and, of course, the inevitable clamps.

Cutter Care and Grinding

The care and conditioning of cutters for this operation is no special problem, other than in the proper organization and setting up of effective and smooth-running machinery.

A word of caution: As this operation calls for a grade of carbide that differs from those used ordinarily on steel and cast iron, it will be necessary to bring this to the attention of the cutter-reconditioning division or personnel. This calls for the specification on proper forms, not only of this different grade of carbide that will resist the abrasion caused by sandy inclusions and a dirty surface but also of the cutting and clearance angles that this operation on cast steel calls for.

It may be well to consider here the addition of another angle, namely a 45° nose angle instead of the customary 15°. If the former were used, the shock to the carbide arising from contact with large, irregular-surfaced castings, such as this ship beam, is considerably softened because the chip thickness is reduced by sin 45°, or 0.707 (Fig. 19).

The tooth load, if the feed rate of 17 ipm. had been used, would have been reduced from 0.011 in. to approximately 0.008 in. Perhaps the advantages of this actual reduction in the chip thickness is not so great when the tooth load is only in the neighborhood of 0.010 in. as it is here.

But it is of great advantage when the tooth load is large and when it is necessary to reduce breakout of the leaving edge. In many specifications breakout is ruled out and must be curbed, or at least restricted, by some such practice as a reduction of chip thickness while the feed rate remains the same. This reduction would be important if 50 hp. were available.

In a properly built and designed machine tool, the K-factor for cast steel in a planer-type machine would be not over 0.5. With 50 hp. applied to the spindle, it is safe to assume that 100 cu. in. per min. can be removed without distress in any member of the setup.

If the sectional area of the cut is 2.25 sq. in., the feed rate would be 44 ipm. and the tooth load 0.028 in. If the cutter has a 45° nose angle, the actual chip thickness will be approximately 0.018 in. The cutting time will be reduced from 24 to 6 min. This is the way to get a job like this done. Moreover, a 50-hp. spindle machine will cost little more than a 20-hp. machine.

Surface and Tolerance

Specifications for surface and tolerance of the finished piece are sufficiently liberal, so there is no cause for concern or delay. Both finish and accuracy are exceptionally good, as indeed they should be at this light metal-removal rate.

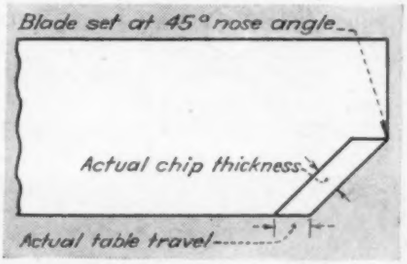


Fig. 19—Changing nose angle from 15° to 45° softens the impact shock on carbon blades as chip thickness is reduced by the sine of the angle

As the latest technique of carbide milling does not permit wasting time taking two cuts, roughing and finishing, the 0.375-in. depth of material is taken off in one pass. And the finish is better than in the days of

roughing and finishing cuts. With correctly specified cutting and clearance angles, the only restriction on obtaining proper finishes is the rigidity of both workpiece and machine. Given these and finishes are no longer the result of a time-consuming set of operations—breaking down a milling job into two passes, roughing and finishing.

CAST IRON

THREE classifications of cast iron—normal, modified and special—will be considered in setting up properly a milling job around respective components. The terms "normal," "modified" and "special" certainly have no metallurgical justification; neither have the classifications.

By normal cast iron is here meant a cast iron with the usual percentages of carbon (2.5 to 3.5%), silicon, manganese, sulphur and phosphorus and above all, a tensile strength of about 25,000 psi. It is no longer used as frequently as it was less than a decade ago. It still has its uses and will, no doubt, so continue, particularly in machine-tool parts that are not subjected to any considerable stresses and wear.

It will also continue to be used for equipment parts where strength is not a factor, such as for furniture. But these latter applications call for little if any machining, particularly milling. Its continued use, however, justifies consideration of its milling with carbide and the latest carbide technique now so successfully used.

Of more importance, industrially at least, is the so-called modified cast iron. The term is used only for present purposes, and has no other relationship or connotation. It refers to those cast irons that are modified, by addition of steel, for example, to form the mis-named "semisteel," or to cast irons that have from a pinch to a slug of alloy addition to give greater strength or other physical characteristics desired.

This term also includes, arbitrarily, those cast irons, such as Meehanite and Linite, that have a greatly increased tensile strength, solely because they have been made under controlled conditions. Their virtues derive not from the addition of other materials but from their better bringing-up and preparation. They are the educated among the cast-iron clan.

Finally, there is necessarily another cast-iron class added; its reference tag will simply be "special" and will include all cast irons that, for such applications as wear purposes, have extremely hard skins or surfaces. It is the latter, particularly, that demand special consideration from production personnel in setting up the operating characteristics of a milling job.

NORMAL CAST IRON

JOBS in each class will be considered in the order discussed. The first of these is normal cast iron. The recommended ten steps will be taken with each of these jobs in making or planning their production.

Identify Material

This first step is again prominently underscored for the personnel in charge of production planning, as its proper execution will determine the results of operations on these materials.

It is not sufficient to know that the material in the component (Fig. 20) for a machine-tool base is cast iron. It is necessary to know that it has a tensile strength of 25,000 to 30,000 psi. if the carbide milling of this material is to be effected economically. As specifications show it has a tensile strength in this range, it is classified as normal cast iron.

Select Surface Rate

The surface rate automatically settles in the range between 300 to 450 sfpm. as soon as the component is identified as normal cast iron. This range of 150 sfpm. is necessary to accommodate various jobs and circumstances encountered.

Ten jobs, for instance, may be all specified of the same cast iron, but some may be better milled at 300 sfpm. and some far better at 450 sfpm. If the workpiece has thin sections and the cross-sectional areas to be milled are narrow with great danger of breaking out along the leaving edge, then the higher surface rate should be applied to reduce the tooth load. The thinner the chip, other factors being satisfactory, the less breakout will be encountered.

Also, where maximum cutter life is necessary, that is, where downtime on the machine is costly, as on a production line, it is well to give full and thoughtful consideration to application of lower surface rates to increase the time between grinds. This is not always necessarily so, and yet the life difference with rates between 300 and 450 sfpm. on the same job may be considerable. A little preliminary experimentation and the addition of considerable experience will usually yield the right answer.

Where neither breakout nor downtime on the machine are important factors, then a surface rate of 450 sfpm. will probably be chosen. It is specified for this operation being performed on a milling machine designed, fortunately, for carbide milling. This machine tool has the necessary built-in features: a 340-lb. flywheel, 16 in. in diameter, electrical braking system and a separate table feed drive.

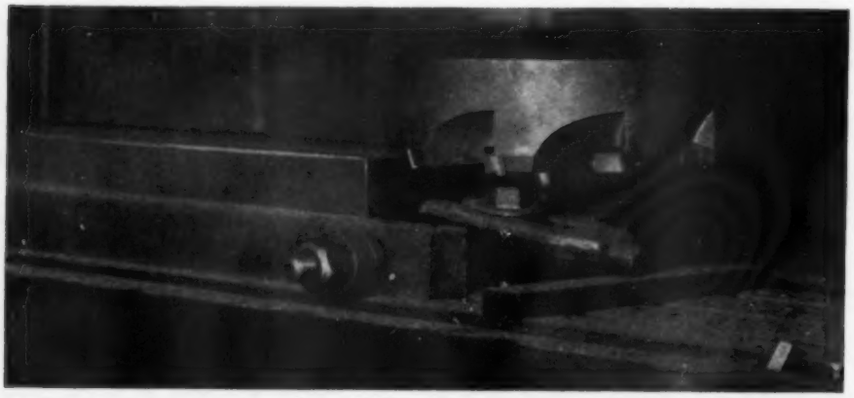


Fig. 20—Solid blocks of normal cast-iron can be milled at 450 sfpm. with 150-cu. in. per min. removal rate on a 50-hp. miller. Feeding from left to right directs cutting forces toward the machine column and means less vibration

This latter design feature is essential in carbide machining. If a cutter is stalled in a cut, the carbide tips, or blades, are damaged frequently beyond repair and to the tune of dollars per blade. With a separate motor drive on the table and overload relays on this motor, any excessive call for power on the spindle motor will gracefully be referred to the table motor. So the spindle motor is free to continue running while the table-motor overload throws open the circuit. The cutter frees itself and damage to costly carbide blades is prevented by stopping table travel.

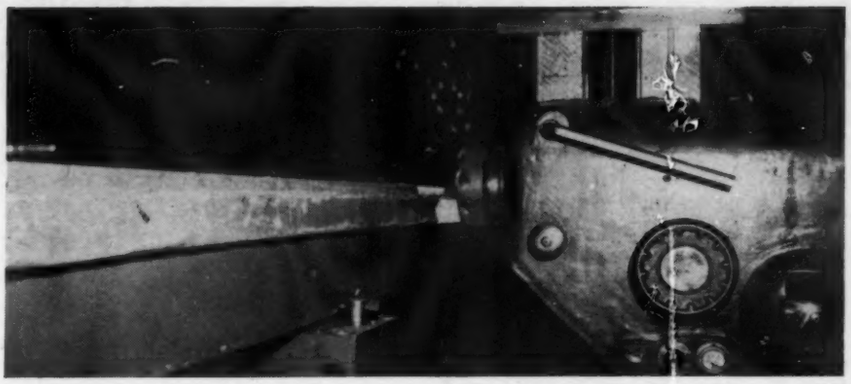


Fig. 21—Machining a machine-tool, semisteel bed on a planer-type miller is better done with a 10-in. cutter than the permissible 6-in. cutter as there is less wear per blade. Setting the cutter high insures heavy chip thickness at beginning of cut and directing of cutting forces downward

Metal-removal Rate

The metal-removal rate of this cast-iron component, approximately 5 in. wide x 10 in. high x 20 in. long, depends on the power available at the spindle. There are no limitations in the piece itself, in its ability to be held securely and rigidly or in its specifications, either for breakout along the leaving edge or for surface finish or accuracy. All these are such that it is possible to remove large volumes of metal without deterioration in finish, edge condition or accuracy.

Correlate Rate with Power

This 50-hp. machine, actually 55 hp. as there is also a 5-hp. motor on the table, can remove 150 cu. in. per min. of this cast iron without any signs of distress. The K-factor for this machine and this material, with the correct carbide-milling technique, is 0.3.

Select Cutter and Diameter

Selection of the cutter for diameter is, by recommended ratio, 8 in. for a 5-in. wide surface to be milled. Cutting and clearance angles should be carefully specified. These can be taken from Table II in which the cutting angles for this material are given as 10° positive radial rake and 7° negative axial rake. These, together with a 15° nose angle, result in positive true rake of 8°.

Clearance angles are significant: 7° peripheral clearance angle, 0° face cutting edge angle and 7° face relief angle.

Establish Feed Rate

The feed rate can now be established from the foregoing data: width of cut—5 in., depth of cut—0.400 in. and metal-removal rate—150 cu. in. per min. The cross-sectional area is, therefore, 2 sq. in., and the feed rate is 75 ipm. This machine is equipped for 90-ipm. feed rate, so the 75-ipm. rate selected can be met.

Check Tooth Load

The tooth load is $75 \div (8 \times 225) = 0.042$ in. As the nearest dial reading to the spindle speed necessary for a surface rate of 450 sfpm. is 225 rpm., the latter valve is used in the calculation.

The tooth load of 0.042 in. seems high according to former practice. It is not only not objectionable here, but of advantage in terms of increased cutter life. The thicker the chip is, the fewer are the cuts needed to mill out a given area and the fewer are the tooth contacts with the workpiece. This naturally increases time between grinds which is usually the ultimate objective of the shop—or it should be as machine downtime and cutter change cost money.

As breakout is of no consequence, the large tooth load can be permitted to stand for another reason. But if breakout were an important factor and the tendency were to reduce the feed rate and hence the tooth load, the first move in that direction would be to increase the nose angle to 45° to reduce the actual chip thickness by sine of the angle, or in the ratio of 1 to 0.707.

Specify Milling Method

The center line of the cutter should be offset from the center line of the workpiece. The table is moved in until the front edge of the work is almost in line with the center of the cutter or until the cutter just covers the rear edge of the work.

The cutter is a right-hand mill and the component is being fed from left to right. Thus the cutting forces are directed away from the front of the machine and toward the column face. This is the correct way to direct cutting forces: against a solid portion of the machine that was meant and designed to absorb them without distortion.

The other direction for cutting forces to be directed would mean far more vibration in the setup. This may be serious when taking a cut as heavy as this one. Fifty horsepower are being delivered to the cutter, the chip is over 0.040 in. thick and the feed rate is 75 ipm. All this adds up to large cutting forces and necessity for application of common sense to the setting up of cutter-and-workpiece relationship so vibration is avoided.

Cutter Care and Grinding

The cutters used on this operation should be correctly tagged for cutting and clearance angles. For cast iron the grade of carbide is straight tungsten carbide, which has the greatest resistance to wear and abrasion of all the sintered carbides now in use.

It will resist the wearing effect of sand inclusions in cast iron and steel, whereas steel-cutting grades, having an addition of titanium, are much stronger but have not nearly the wear life in the face of operations such as this. Tungsten-carbide blades must, for successful milling, be specified for all cast irons.

Surface and Tolerance

As already indicated, neither finish nor accuracy of this block of cast iron intended for a machine-tool base is important and need not enter

into these considerations. Yet it is interesting to note that the finish, even with the heavy tooth load, is 60 microinches and the flatness, when checked with a surface plate, is better than 0.002 in.

MODIFIED CAST IRON

THE BED of a machine tool (Fig. 21) is being milled on a planer-type machine. This component is of semi-steel with a tensile strength specified as 50,000 to 60,000 psi. and a Brinell hardness above 180. This serves to identify and classify the material.

A surface rate of 300 sfpm. is the highest rate that can be applied to this material and have economical cutter life. It may be necessary to reduce the surface rate to as low as 250 sfpm. if the cutter life between grinds is not entirely satisfactory.

The width of the face to be milled is 4 in. It would be permissible to choose a 6-in. dia. cutter, but the amount of metal to be removed and the rugged character of the operation indicate the need for a cutter of large diameter.

More Carbide, Less Wear

A 10-in. face mill is specified so the advantages of more carbide blades and less wear per blade to remove a definite amount of metal are enjoyed.

The cutting angles are selected from Table II. For modified cast iron the cutting angles are the same as specified for standard steel and should be carefully observed to obtain maximum carbide life.

The metal-removal rate depends solely on the amount of horsepower available at the spindle of the machine and its general suitability for carbide metal removal. The workpiece is sturdy enough to absorb large cutting forces.

As the machine assigned to this operation has a 30-hp. motor and as the K-factor for this machine and material is 0.5, it is possible to remove 60 cu.in. per min.

The width of face milled is 4 in. and average depth of cut is 0.300 in., making the cross-sectional area 1.2 sq.in. The feed rate then is 60 ÷ 1.2 = 50 ipm. The top feed rate of this planer-type machine is 35 ipm., so the metal-removal rate must be restricted to not more than 42 cu. in. per min.

The tooth load is 35 ÷ (10 × 115) = 0.030 in., approximately. This is a favorable chip thickness for this milling job.

The 10-in. dia. mill is set as high above the component as possible and still clear the bottom edge of the face to be milled. This insures a heavy chip thickness at tooth entrance and all the cutting pressures directed downward as they should be.

If the zero line of the face cutting edge angle is ground 0.030 × 10 = 0.300 in. long (somewhat more is necessary to cover the feed marks with a certainty), then the finish will be excellent and show no feed marks.

SPECIAL CAST IRON

THE CASTING (Fig. 22) has been chilled on the surface being milled to provide necessary wear qualifications for intended application. The milling of this workpiece begins, as always with proper planning, with identification of the material to be machined.

As specifications call for chilling of the surface, this has been done. Also as the Brinell number of this surface is between 550 and 600, the surface rate selected is in the lower brackets—125 sfpm.

Cutter diameter is strictly limited by workpiece dimensions. Milling of the surface shown is between shoulders, and this dimension will not accommodate a cutter larger than 8 in. in diameter.

Cutting and clearance angles are selected from Table II. The cutting angles may be considered as critical, so the application of a 10° negative radial rake and a 7° negative axial rake angle is important.

Clearance angles are 5° peripheral clearance, 0° face cutting edge and 5° face relief. These smaller clearance angles are important for economical carbide life. The smaller the clearance angle, the greater is the strength of the carbide blade at its cutting edge and therefore the less likelihood is there of its crumbling or breaking away under the impact of cutting forces.

The carbide grade to be selected rests largely, if not entirely, on the manufacturers' recommendations. Tungsten carbide is the basic sintered material for such operations, as resistance to friction and abrasion must be high to provide respectable cutter life.

The workpiece is of such construction that its metal-removal rate cannot possibly be higher than 50 cu.in. per min. Its walls are relatively thin and the distance of the surface being milled from the base of the casting is approximately 14 in.

This does not add to the ability of the piece to withstand a heavy metal-removal rate; in fact, the entire setup, workpiece construction, design and method of holding, which is only mediocre—all militate against a high metal-removal rate. Experience points to an estimate of 50 cu.in. per min. This figure has been confirmed under actual operating conditions.

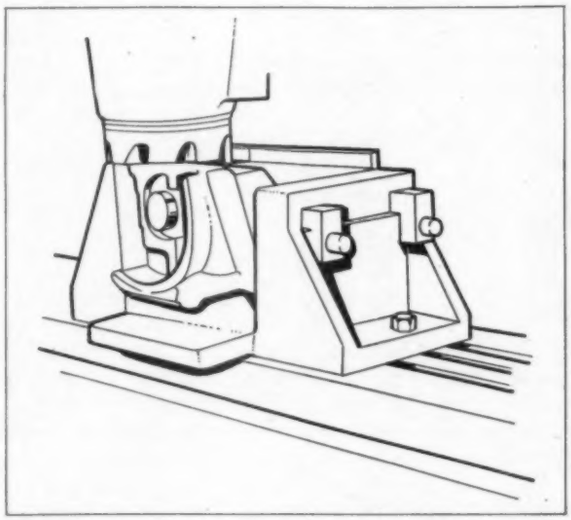


Fig. 22 — Chilled casting with relatively thin walls can stand only a low metal-removal rate of not more than 50 cu. in. per min., but the 15-hp. machine rating limits the removal rate to 7.5 with K-factor of 2

The machine designated for this operation is a 15-hp. knee-type machine of standard construction, that is, not specifically designed for carbide machining. So the K-factor on this machine, while milling a workpiece with a Brinell hardness of 600, is 2.

Consequently, the 15 hp. available will not remove more than 7.5 cu.in. per min. The metal-removal rate, very definitely then, is determined by the machine in spite of the disadvantages of workpiece construction and design.

Calculate Feed Rate

The feed rate can now be calculated as follows: As the full 8 in. of cutter diameter will be in the cut at all times, the width of cut is 8 in. The surface rate selected is 125 sfpm., which with an 8-in. cutter calls for a 60-rpm. spindle speed which is available on the machine.

The cross-sectional area is 8 × 0.125 (the depth of the cut) or 1 sq. in. If the metal-removal rate is taken as 7.5, the feed rate is 7.5 ÷ 1 = 7.5 ipm.

Tooth load can now be determined as 0.015 in. This is excellent, considering the limitations under which the operation must be planned and performed.

The method of milling is restricted by the nature of the job. A left-hand face mill is specified to bring cutting forces against the column face. Otherwise, the milling operation setup has little choice left in its makeup and is completed.

Cutter grinding and reconditioning machinery must assure grinding into the blades the special angles called for by this special cast iron. Cutting and clearance angles are unusual and must be emphasized to assure their availability in the cutter as ground.

Surface finish specified is 30 microinches. With material of Brinell hardness over 500, this becomes relatively easy to accomplish. As hard materials take an excellent finish, a microinch specification as low as 10 can be met.

MALLEABLE IRON

THE OPERATION (Fig. 23) is on an airplane malleable-iron component held in a fixture.

Its designation as malleable iron identifies this component. And, from experience, the surface rate applicable to malleable iron is between 350 and 400 sfpm. The lower reading will be selected for this operation. This is not an arbitrary decision but is based on the flimsy character of the workpiece and the difficulty of holding it.

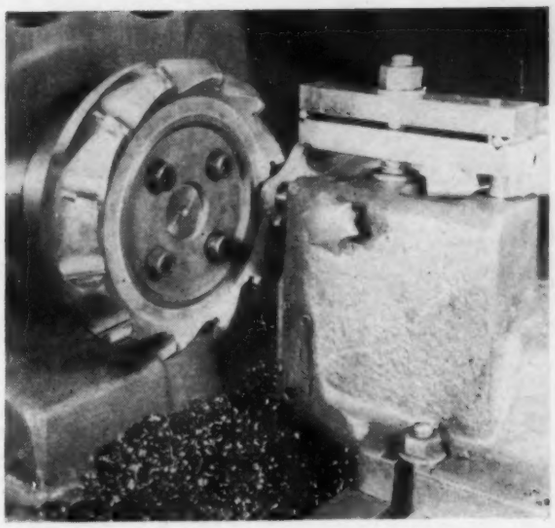


Fig. 23—Malleable iron is milled with the same cutter angles as specified for modified cast iron in Table II but at higher surface speeds. At 350 sfpm. and 10-ipm. feed, tooth load is 0.0075 in.—somewhat low but as high as machine and workpiece will allow

The cutter is an 8-in. face mill with tips brazed direct to the body. Selection of carbide grade for such materials, as this airplane component, is better left to the carbide manufacturer. A grade of sintered carbide somewhere between the straight tungsten carbide used on cast materials and the tungsten-titanium carbides used on steel is required here. It is a grade that is frequently specified for cast steel and even the more rugged cast-iron jobs.

Negative Rake Required

Cutting- and clearance-angle selections can be made from Table II. Malleable iron is included in the category "modified cast iron," so cutting angles are 7° negative radial rake and 7° negative axial rake. This results, using a 15° nose angle, in a negative true rake of approximately 7°.

Determination of metal-removal rate in this operation will be a race between two weaklings: the workpiece that cannot stand a heavy cut because of its construction and the machine that is powered with a 10-hp. motor. This motor drives two spindles operating at the same time, although only one spindle and one face-milling pass is shown in the illustration.

The face width of the cut taken is approximately 4 in. and the depth of the cut is approximately 0.200 in. The cross-sectional area of the cut, therefore, is 0.8 sq.in. For this material and this type of machine, the K-factor is not less than 0.6 so this machine cannot remove more than 16 cu.in. per min. total, or 8 per spindle.

Under these conditions, the feed rate can be established as 10 ipm. With 350 sfpm. and therefore a spindle speed of 165 rpm., the nearest dial reading to the spindle speed required to give 350 sfpm. with an 8-in. cutter, the tooth load is approximately 0.0075 in. This is decidedly on the low side, but restrictions placed on this job by both workpiece and machine make it necessary to welcome this set of conditions.

In fact, this operation represents a 60% saving in floor-to-floor time over the older high-speed-steel method. The saving in downtime on the machine, because of greater cutter life, is even more remarkable; this important cost factor was reduced 55%.

NON-FERROUS MATERIALS

THE OPERATION (Fig. 24) is the milling of a bar of 14-ST aluminum alloy, which is one of the more difficult alloys to machine. It is high in silicon, and its abrasive effect on cutting materials dulls the cutting edge sufficiently to reduce the sur-

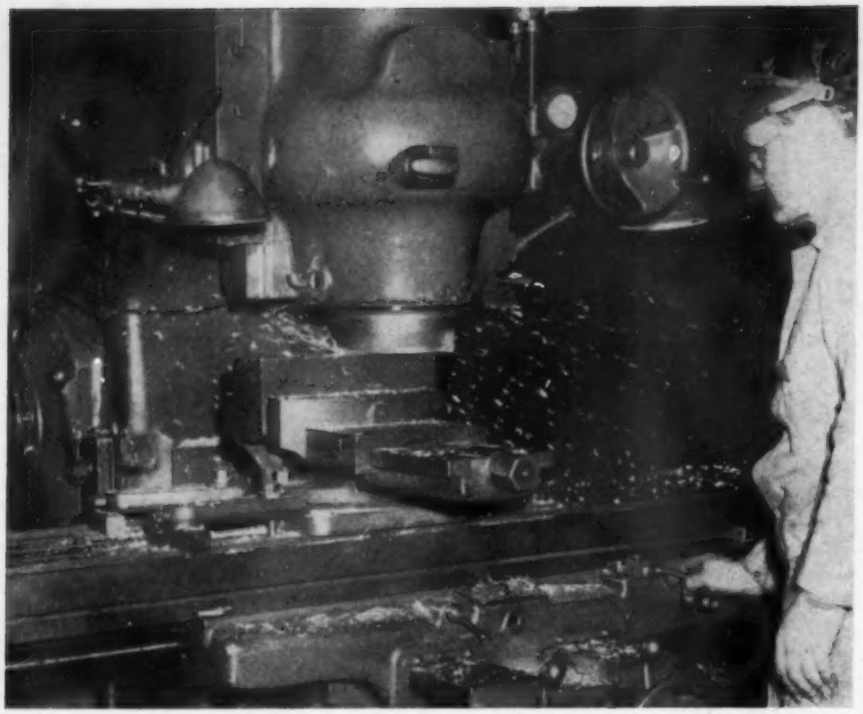


Fig. 24—Milling 14-ST aluminum alloy at 2,900 sfpm., 60 ipm., 75-cu. in per min. metal-removal rate and 0.0045-in. tooth load yielded 5-microinch surface finish with proper cutting and clearance angles on cutter. Clearance angles are critical for obtaining mirror-like finishes

face finish. Unfortunately the latter is always, or almost so, one of the prime requirements in the specifications.

Identification of a workpiece as an alloy of either magnesium or aluminum places it immediately in a special category insofar as surface rates are concerned. There is no known ceiling on speeds at which these materials can be milled.

In regular production they have been machined at rates as high as 25,000 sfpm. Recently one of the machine-tool builders made available a bed-type machine with a maximum spindle speed of 6,000 rpm. This, with an 8-in. cutter, yields a surface rate of 12,600 sfpm. But, to repeat, there is no known upper limit.

The job is here being milled on a standard knee-type machine with a top speed of 1,300 rpm. With the 8-in. cutter, the surface rate is 2,900 sfpm.

The metal-removal rate in an operation of this nature is of little moment. The piece being milled is 5 in. wide, and the depth of cut is 0.250 in. The cross-sectional area is, therefore, 1¼ sq.in. The milling machine has a 15-hp. motor, and with top speed and feed, the K-factor is 0.2.

This results in the possibility of removing 75 cu.in. of this material each minute. At 60 ipm. and a sectional area of 1¼ sq.in., the metal-removal rate is 75 cu.in. per min. Under these conditions, the machine is loaded to normal capacity.

A rapid traverse cut was also taken on this workpiece. This represents a feed rate of 150 ipm., which with an 8-in. cutter operated at 1,300 rpm. is equivalent to a tooth load of 0.012 in. For this purpose, however the depth of cut was reduced to 0.125 in. so as not to overload the machine appreciably. At any rate, the equipment gave no signs of distress.

Excellent Finish Possible

Returning to the feed rate of 60 ipm., which was used in a production setup for the skinning of these billets, the tooth load of 0.0045 in. yielded excellent surface finishes measuring about 5 microinches.

Obtaining such finishes is not difficult, provided the proper clearance angles are specified. It is important that the face relief angle be specified as 15°. The periphery clearance or relief angle can be greater than 7° although this is the minimum. A cutting angle of 15° positive radial rake is also most desirable.

The clearance angles listed above are considered critical. Without them, it is impossible to obtain good finishes, particularly ones that are characterized by clear and unmarred mirror-like sheens.

The microinch reading of 5 is not too difficult to obtain although good cutter life at this finish is obtained only when the carbide blades are honed with a fine-grit diamond hone. The grade of carbide for this operation is important and should be specified by the manufacturer. A slippery steel-cutting grade is generally recommended.

FOR MILLING SUCCESS

IMPORTANT in all carbide milling, regardless of material specification, is the analysis of each job in ten steps.

Specification of the surface rate is independent of all factors, except classification of the workpiece. Surface rate then determines spindle speed.

Cutter diameter and other characteristics depend on workpiece and the type of operation to be performed. Cutting and clearance angles must be specified at this stage of the analysis. Clearance angles, particularly, are to be considered critical for many materials. Unfortunately, the information made available frequently in this regard is erroneous and not based on either experience or sound experimentation.

The metal-removal rate inherent in the workpiece should now be considered. Only experience however can determine the rate at which it is justifiable to remove metal from a workpiece. The metal removal made possible by type of machine and its power is now used to arrive at proper loading of the equipment and subjection of workpiece to maximum cutting forces.

The analysis has now arrived at the point where the feed rate can be calculated in terms either of the metal-removal rate in the machine or the workpiece, whichever is the smaller. There remain only the type of milling to be specified and the checking of the first fruits of the run for surface finish and accuracy, which may mean changing of operating conditions to obtain the called-for finish and accuracy.

OUR TEACHERS—

They Need The Help Of Business Now

THIS is an appeal to raise school teachers salaries—fast. Such appeals are commonly addressed, rather vaguely, to the conscience of the community. This one is not. It is addressed directly to the business community, and to its hard core of common sense.

As a whole, the school teachers of the nation are taking an economic beating. So, too, are their close associates and co-workers, the librarians. In purchasing power, public school teachers salaries, after taxes, average about 20 percent less than they did eight years ago. Beginning salaries of librarians, always low, have fallen behind an equal amount in purchasing power. College and university teachers are not much better off. The pressure is particularly heavy on those in the lower ranks. As a group, teachers and librarians are close to the bottom of the economic heap.

Unless this situation is remedied promptly, it is confidently to be expected that:

1. The more competent teachers will continue to desert our schools in droves, and our libraries will remain inadequately staffed. More than 350,000 teachers — many of them the very able ones—have left the public school teaching staff of about 900,000 in the last six years. More than 100,000 of the replacements are "substandard." They cannot meet the minimum educational requirements of their jobs which, by admission of the profession itself, are none too high.

2. Those who remain will be organized increasingly into economic pressure groups. Teachers strikes and the rapid growth of unionism among teachers at present clearly indicate what is in store.

Many business men are so deeply disturbed by the resort to the strike weapon by some teachers to enforce their salary demands that their sympathy for the general plight of our teachers tends to be dulled. Such an attitude is understandable. It avails nothing, however, in eliminating the crisis in education caused largely by teachers salary troubles.

The crisis in education is a crisis for the nation as a whole. The work of our schools, colleges and libraries is such that its deterioration means deterioration of the nation. However, the salary crisis in education is in special measure a crisis for the business community. That community has a special stake in having a well-educated and well-disposed constituency.

Education and Unionism

There may be room for disagreement as to whether teachers should organize themselves in trade unions, and follow trade union tactics. However, there is no conceivable room for disagreement as to whether organization of teachers into a fighting economic pressure group under the lash of a teachers salary crisis would be a body blow to business. Among many teachers it would foster an abiding hostility to the institution of business which, occupying a key position in the life of the community, had not done its utmost to make such unionization unnecessary by taking a lead in relieving the teachers salary crisis.

In our work of publishing technical periodicals and text books, we at McGraw-Hill meet and come to know many teachers and librarians. We know that, as a group, they have little appetite for participation in militant economic pressure groups. They are far more interested in making a militant assault on ignorance and prejudice through concentration on their professional work. If, through neglect of their economic needs by the business community, they feel forced to resort to trade union organization and tactics, the teachers and librarians can be expected to have an abiding re-

sentment toward the institution of business. That resentment will, in turn, be communicated in no small measure to the coming generation. Such is the nature of the educational process.

The crisis in education is not, of course, exclusively a matter of salaries. Unsatisfactory working conditions also play a part. Many schools are dilapidated and terribly overcrowded. So are some libraries. Some small-town school boards oppressively insist that the school teachers be the paragons of piety the board members wish they were themselves. Protection of a proper degree of academic freedom is sometimes missing. The teacher is rarely accorded a prestige comparable to the importance of the job. Elements such as these aggravate the crisis in education. But the first and absolutely essential step toward surmounting the crisis is to provide tolerable salaries.

Because of the enormous diversity of local conditions affecting teachers and librarians salaries, no general rule for emergency action would fit all cases. From state to state, average yearly expenditures on education in 1940 varied all the way from about $30 per pupil to about $150. Some states, like Nebraska, finance their schools almost exclusively from local taxes. Others, like Delaware, rely almost entirely on state taxes. Some states and communities have already acted to meet the salary crisis. Others have not. Variations such as these limit any generalization.

Guide for Emergency Action

But as a general proposition it can be safely said that the minimum requirements of the emergency will not have been met so long as the salaries of class room teachers and junior members of college faculties and library staffs have not been increased by the amount necessary to keep them abreast of the increase of about 50 percent in the cost of living since 1939. In many cases, a temporary cost of living adjustment might prove the best way to handle the problem.

This suggestion, let it be repeated, is not offered as a solution of the salary problem, but as a start. With their salaries increased enough to meet the increased cost of living, the teaching and library groups as a whole would still have cause to envy the current economic position of industrial workers. Since 1939, the average of weekly earnings of industrial workers after taxes, has outstripped the rise in the cost of living by about 21 percent.

However, a start and an absolutely essential start would be made toward giving America the sort of educational system it must have not only to fulfill its ideals but holds its own in this highly competitive world. We worry, and I think rightly, about having the free world engulfed by Russian Communism. According to the best figures available, the U.S.S.R. is spending about twice as large a share of its total national income for education as we are. The figures compared include our expenditures for both public and private education. That comparison is really something to worry about.

States Should Take Lead

In dealing with the salary crisis it is up to the teachers to display a maturity and integrity worthy of their profession. Teachers have many employment advantages, such as long vacations. They should not slur them over in making comparisons of their annual incomes. Also employment in teaching and libraries has been notably stable. Teachers and librarians should not ignore that fact in comparing their position with those whose employment has been far less steady.

At the same time, the great fiscal difficulties involved in solving the crisis in teachers and librarians salaries must not be used as an excuse for postponing effective action. The states are better equipped financially and otherwise to take such action than is the federal government and, with the localities directly involved, should take the lead. If the price of effective action is a heavier tax burden for communities already too heavily burdened that price must be paid. The crisis presents a major emergency. To handle it as anything less is to court irreparable damage to the nation as a whole, and a special measure of damage to business as well. The intelligent self-interest of business requires that it leave nothing undone to meet and master the crisis in education.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc

TALKING SHOP

Speller Feller

BRITAIN and the U. S. have a military agreement which proposes standardization of weapons. It poses some pretty problems. There's U. S. Army use of millimeters, inches and calibers to indicate bore diameters, U. S. Navy use of "caliber" to mean tube length. There's Britain's solo use of projectile weight to designate gun size—4-pounder, 18-pounder, etc. That regal setter of records in

marital marathons, Henry VIII, also ordered major changes in English religion, architecture and artillery. His artillery standards, the "Ordinance of Henry VIII," were based on projectile weights. They started not only the exclusively English "pounder" designations, but also the specialized military word "ordnance" —the latter because some poor feller copying the standards was a poor speller as well.

Tipoff

SEVERAL YEARS AGO, Apex Electrical Mfg. Co., Cleveland, inaugurated a policy to disclose fully to employees all important company matters relating to their welfare. Bad news, as well as good, is published—and resulting mutual confidence has become the basis for much-improved morale. Now the company is expanding the plan to include stockholders, will write quarterly informative letters, considering the danger of "tipping off" competitiors less than that of having misinformed or uninformed sources of capital.

Peacetime Bombproof

WESTINGHOUSE Research Labs. is building a special dugout, ringed with heavy sandbags, to test special alloys for jet-engine parts. Alloy disks 1 in. thick by 1 ft. dia., will be heated above 1,400 F. by electric coils as they are spun at 35,000 rpm. (1250 smph.) by an ultra-high-speed electric motor 10 ft. below the dugout floor. During test, the 32-lb. disks are enclosed in ⅛-in. steel hoods, evacuated to reduce friction, but easily penetrated by fragments without damage to the latter. Temperature of the disk will be measured continuously by thermocouples special-welded on to resist centrifugal force 190,000 times their weight. Expanding diameter will also be measured to determine creep.

One Inversion Avoids Many

AUTOMOTIVE BODY BUILDERS are installing some new inverted presses to cut down handling time and conserve floor space. Present triple-acting presses form a steel sheet into a "turret top" with preformed windshield and rear-window openings. The forming punch moves down into the piece, so the formed top is upside down and must be turned right side up before windows are blanked and flash trimmed off. The new presses, made by Clearing, have the punch rising from below, draw rings operated from above. Inverting the press saves the space now needed for inverting the top.

No Cutting—No Coolant

OUR STOMACHS were not the sole sufferers from the recent slaughter moratorium (short for meat shortage). Cutting oils (incorporating fatty acids) and coated abrasives were very short too (no adhesives). One company, at least, after trying all sorts of oils, used olive oil, at a pretty price, for a coolant. Coated-abrasive distributors were short-stocked for six months, could not supply regular customers with even minimum requirements. The shortage is over now—but fatty-acid prices are double what they were.

Odorous Comparison

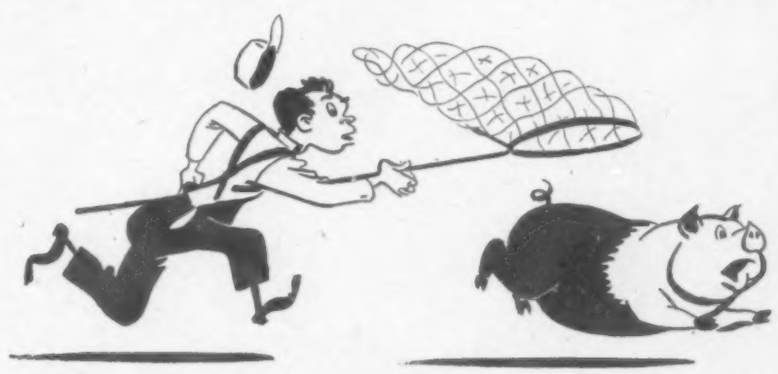
W. T. BEAN, of Continental Motors, follows in the footsteps of his illustrious namesake, Judge Roy Bean, "the Law West of the Pecos," with this sign in Engineering:

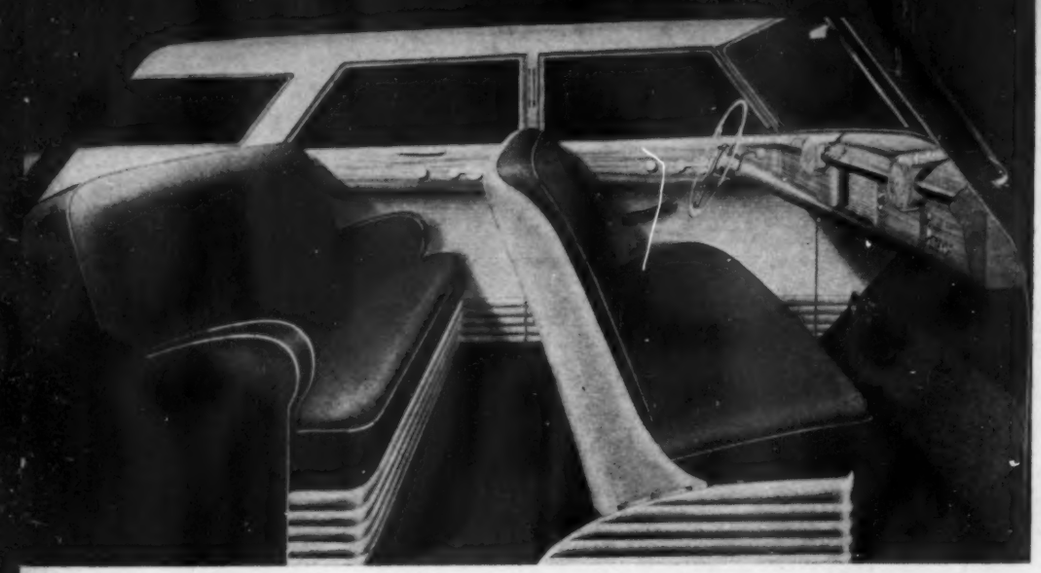
A Bad Design Is Like A Rotten Egg

Its quality is apparent to everyone *after* it is broken

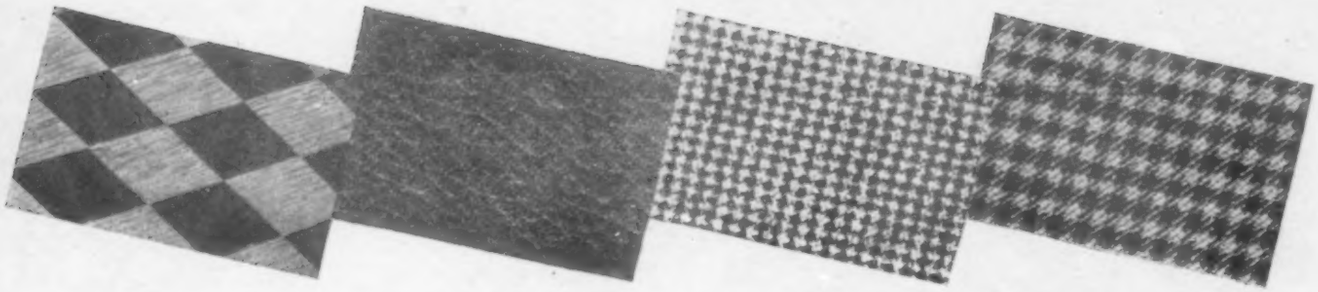
Watch Space for Equipment

ADDITIONAL FLOORSPACE will be required to cope with larger, more powerful machine tools, especially so because of the accessory equipment that may be needed. Machines built for carbides need large, powerful, stock-feeding mechanisms, and means must be provided so these machines are easily replenished. Besides, it is important to allow room for coolant-temperature control equipment, chip conveyors and chip-removal systems. Removal of finished parts with minimum handling is another problem. So, of necessity, the jamming of machines "cheek by jowl," often complained of by workers, must give way to the above considerations. Already cost-conscious manufacturers have provided liberal room in press shops for materials-handling equipment. Machine shops must do likewise.



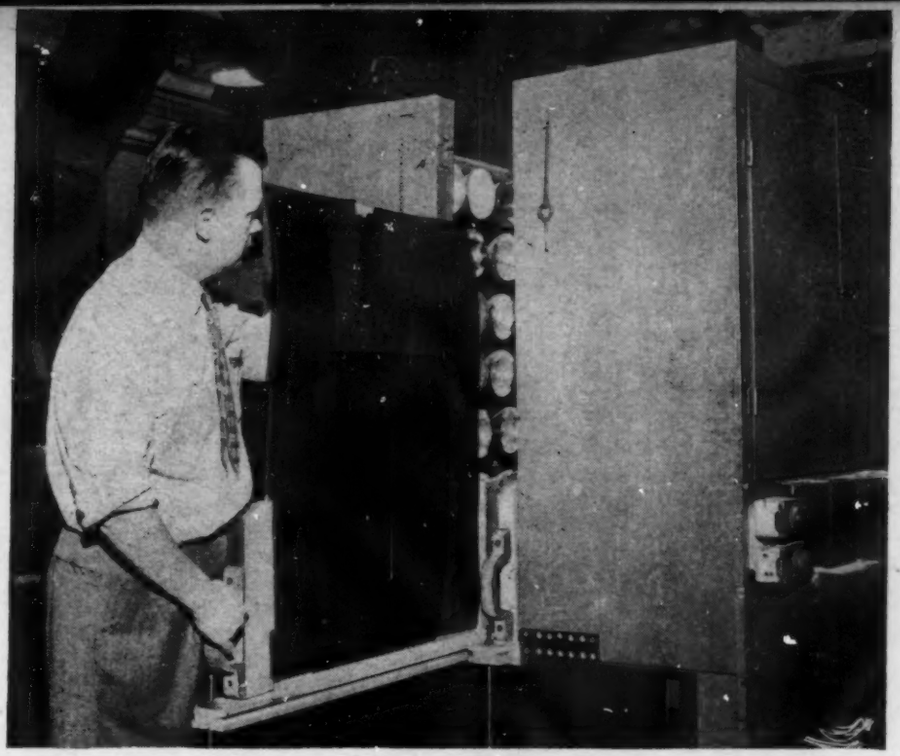


ALL-PLASTIC INTERIOR . . Tomorrow's auto interior, as visualized by designers of Briggs Manufacturing Co., includes plastic head lining, door panels, window garnish moldings, instrument panel, seat cushions and floor mat, as well as conventional plastic steering wheel, door knobs and escutcheons. Any fabric, wood or leather pattern can be photographed and offset-printed in any desired colors, then incorporated in a laminated plastic panel with a surface patterned to duplicate that of the original—including piping, seams and stitching



PLASTICS SIMPLIFY AUTO-BODY TOOLING

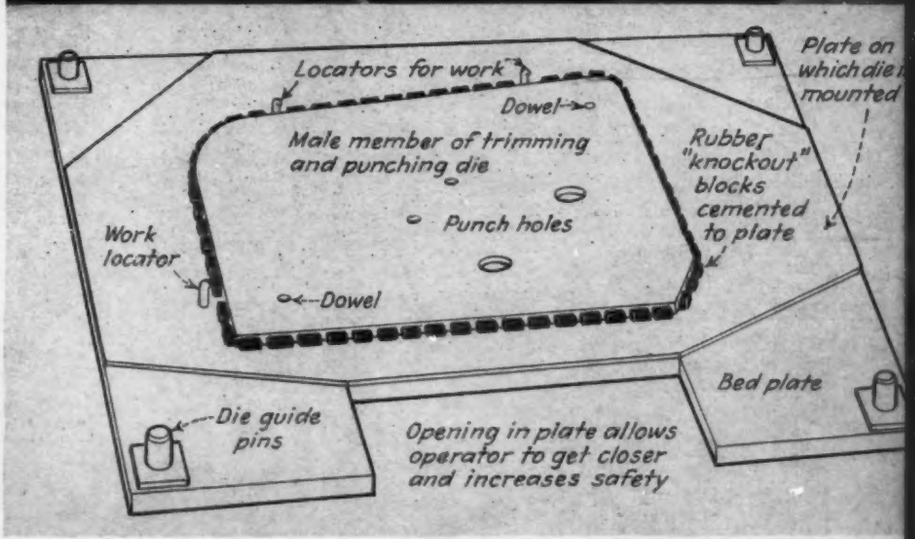
MULTIPLE COLORS, COMPLEX SHAPES . . De Soto "Suburban" door panels have a warm brown walnut burl section within a golden-oak panel, with a leather kick pad at the bottom—all plastics, of course. Photographic reproductions are sandwiched into a durable thermosetting plastic sheet. Panels may be formed to conform to any body shape, are strong, abrasion- and scuff-proof, and may be waxed or polished without deterioration. Unlike paint or transfer-topped metal panels, the surface will not wear off. Further, plastics are not cold to the touch, the surface can be made to feel more like the actual material, yet is easier cleaned and does not spot. Metal moldings are attached by metal clips; the panel is screwed to the door frame



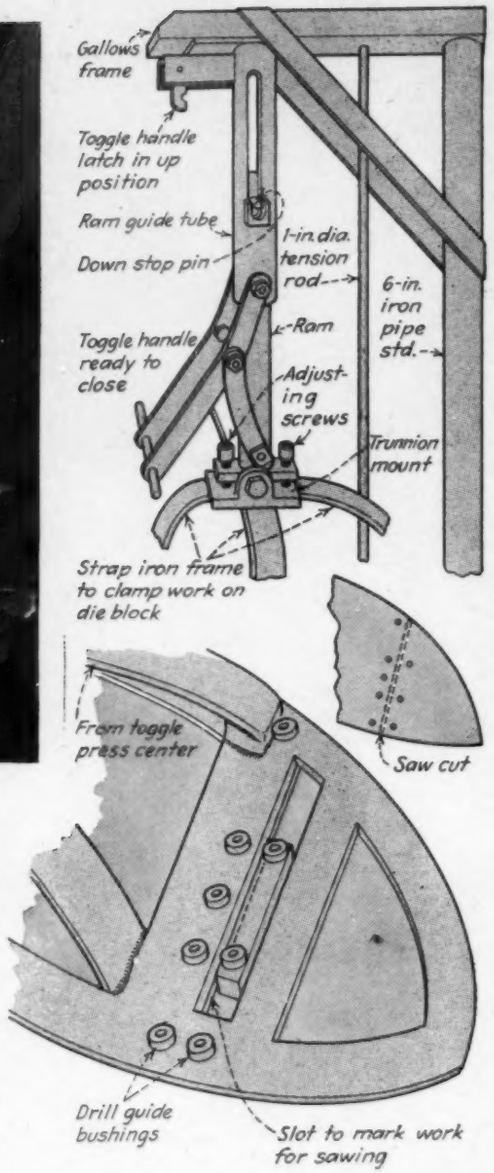
HEATING THE SANDWICH . . Interior door-trim panels are heated automatically by a bank of infrared lamps before they are trimmed and pierced. The flat blank is a "sandwich" of one or more sheets of impregnated paper, topped with an offset-printed paper sheet—or several—assembled as in the DeSoto door panel at left cured under pressure and temperature

Motorcar interiors, styled in plastics as predicted by Briggs Manufacturing Co., body designers, may require new and different fabricating methods to produce

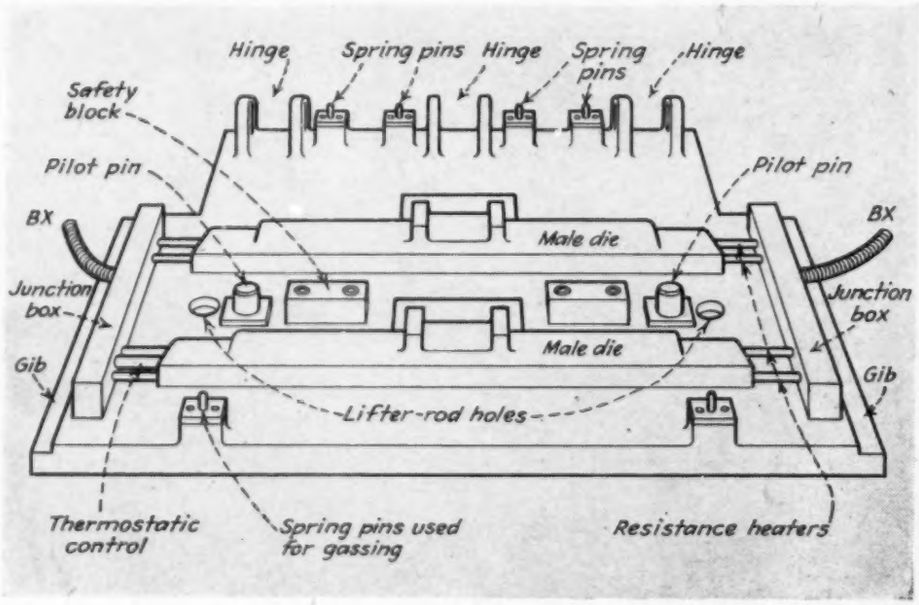
By CHESTER S. RICKER
DETROIT EDITOR


Locators for work
Dowel
Male member of trimming and punching die
Punch holes
Work locator
Dowel
Rubber "knockout" blocks cemented to plate
Plate on which die is mounted
Bed plate
Die guide pins
Opening in plate allows operator to get closer and increases safety

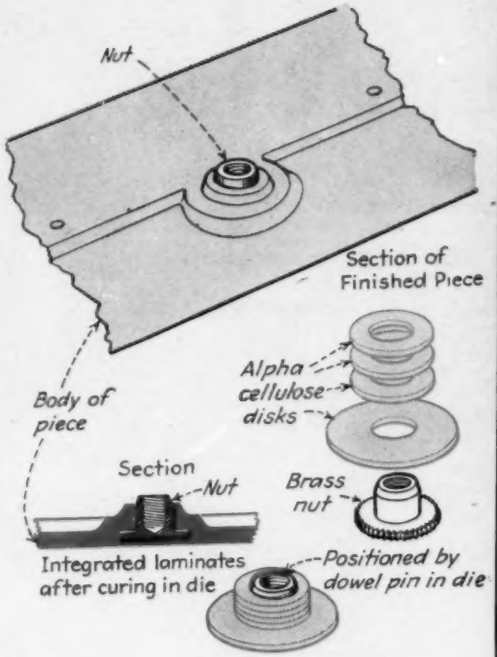
INEXPENSIVE DIES TRIM PANELS . . Laminated panels are trimmed and pierced in inexpensive "clicking" dies made of 0.625-in. chrome-moly flame-hardening steel cut to a templet with a DoAll saw, then flame-hardened on the shearing edge. Rubber blocks around the edge are used as knockouts. Trimmings are fitted together in sections to form the female die mounted overhead. The "die" is doweled and screwed to a ¼-in. steel plate that is in turn clamped to the press bed. This eases die-changing after short runs

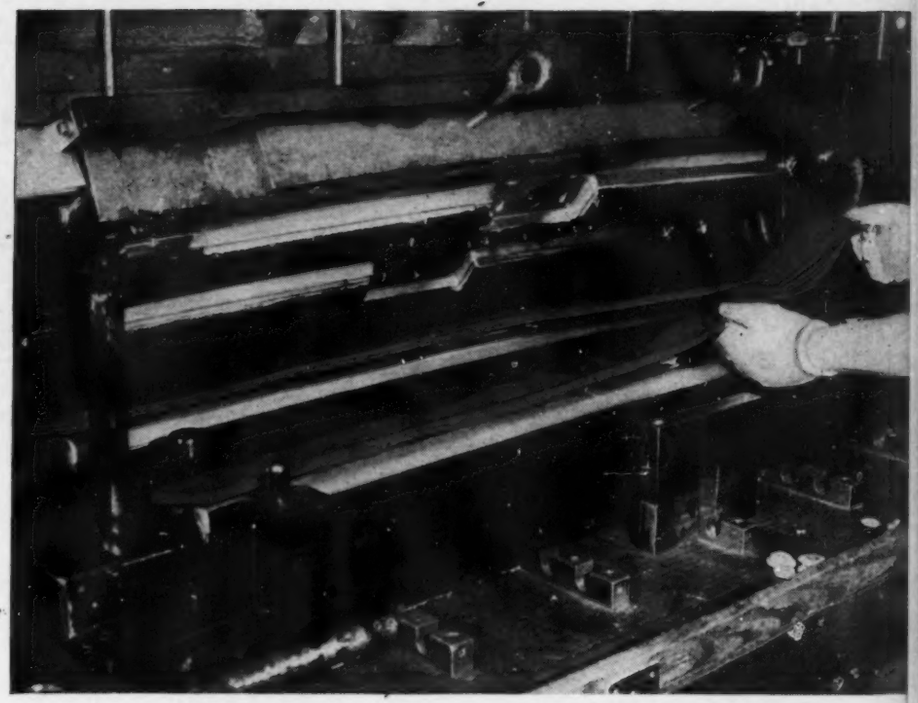


SIMPLE FORMING.. Trunk-lid lining, rear-deck door and rear-quarter section (to clear wheel houses) call for forming the blank. The infra-red-heated stock is plastic, hence can be shaped in this simple forming die at about 250 F. The forming fixture is pictured in open position, with the operator removing a formed rear quarter panel. The lower die is an interchangeable wood block armored with sheet metal (actually a steel wheelhouse stamping), the upper a steel skeleton. Toggle clamps at critical points held the hot sheet until it sets—about 5 min. Dies cost about $1000, as compared with $20,000 for all-steel dies. Toggle action in the clamping device against the strap-steel frame holds the hot laminate until it sets. Clamps are interchanged by removing the trunnion screw. The clamp is supported by a gallows frame secured and braced to the base. The strap-steel frame not only forms the piece, but carries drill guides and slots to mark the piece for sawing, as shown on the detail from the corner of the wheelhouse clamp



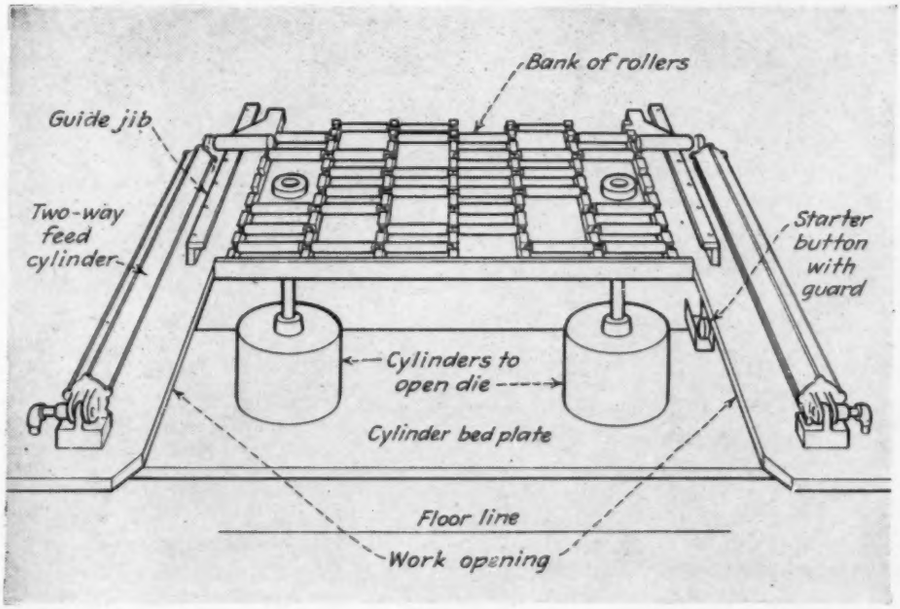
GANGING SAVES TIME.. Two male dies (in this case, for the seat-trim moldings) are carried on one die plate, and heated by inserted Westinghouse tubular resistance units controlled by thermostat. The female die is hinged at rear so it can be lifted by piston rods coming up through the base from air cylinders below. Hinges are slotted so the die can stand slightly open, held by six spring pins, while gassing. Safety blocks prevent mold damage if it is closed while unloaded





"DEEP-DRAWING MOLD".. A 2-cavity mold is used in fabricating the Packard garnish molding. In the photo, the operator is loading 5-ply raw-plastic "sandwiches," supplemented with molded plastic inserts to be cured in the 3-min. cycle. The sketch details how fastening nuts are inserted in the die to become an integral part of a finished piece (in this case a seat-trim molding). The brass nut is knurled to prevent turning. Cellulose disks are punched from sheet stock. Two inserts may also be seen at the center of the front "sandwich" in the photo

PACKARD MOLDINGS.. Garnish moldings for the back of the Packard front seat require sharp corners and deep drawing, so are molded in heated steel dies under high pressure in a 50-ton hydraulic press. The laminated fabric sandwich is preheated in in infrared oven, then inserted in a steel mold. A completed molding with dark mahogany finish is shown. Instrument panels are similarly made

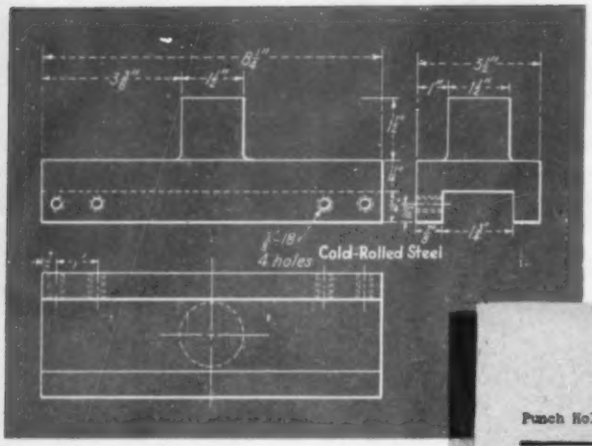


LOAD WHILE CURING.. A power-operated table carries each dual die into and out of the press, and opens it while outside. It is designed to be used on both sides of the press, so one pair of laminates can be cured while another pair of dies is reloaded. The table is operated by twin 40-in.-stroke air cylinders, while 12-in. dia. cylinders with 8-in. stroke open the dies outside the press. The die is handled on a table of 1½-in. dia. rollers carried on slotted bronze strips, and is guided by gibs at each side. Automatic cycling handles the whole operation at the touch of a button (right in sketch)

Incentives Work in the Toolroom Too

Successful more-pay-for-output plan is based on accurate data applied by a standards man with wide experience on tools and tooling jobs

BY E. H. HEYWOOD,
PRODUCTION MANAGER
THE S. S. WHITE DENTAL MANUFACTURING CO.



THIS PUNCH HOLDER for swaging dies is machined from solid, cold-rolled stock. From the print, the standards man lays out operations and then sets standard time for each operation from data sheets

THE WORK SHEET shows all necessary operations, timed from standard data sheets. Setup and standard times are separate to facilitate establishing times when more than one unit is to be produced. Ten data sheets were needed to set standards for the swaging-die punch holder

INSTALLING an incentive system on tool work is a challenge. Maintaining the system and making it tick is often more than a challenge—it is a battle against diversity of product, non-repetition of operation, lack of definite specifications, pressure to compromise and, not least of all, tradition.

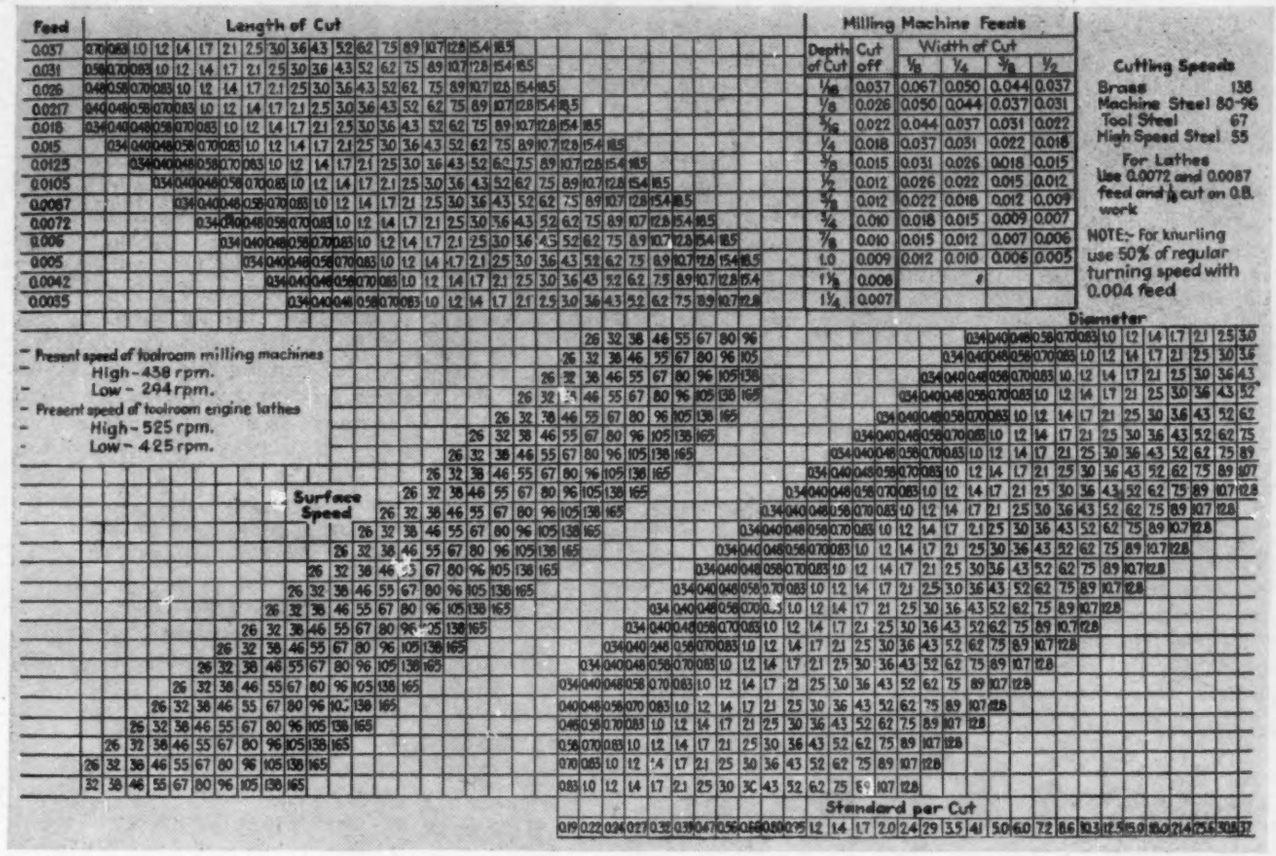
For 17 years we have operated a toolroom incentive plan, successful both in its financial benefits to toolmakers and its manifold benefits to the company. For not only has it raised and maintained higher wages and higher worker productivity, but it has also aided scheduling and production control of tools and machines and lent itself to estimation of standard costs.

Then and now, we believe in a day's pay for a day's work. When a man does more than a normal day's work he is entitled to more than a

WORK SHEET

Punch Holder for Swaging Dies	Set-Up	Std.
Instructions, study blueprint, draw tools	10	
Layout to cut on Do-All and set-up	5	3.00
Cut out 2 sides— 3½ x 3 3/8 in. -- Do-All at 7.0 each side		14.00
Two sets for cutting at 0.50 each		1.00
Cut out 2 sides for shank 3½ x 1½ in.— Do-All at 2.0 each		4.00
Two sets for cutting at 0.50 each		1.00
Set-up lathe to face, turn and face shoulder	3	4.80
Face to 2½-in. diam. across corners 1.4-in. length at 0.0072-in. feed and 80 sfm. -- 2 cuts at 2.0 each		4.00
Two sets to face at 0.15 each		0.30
Turn 2½ to 1½ in. diam. x 1½ in. long at 0.0072-in. feed and 80 sfm. -- 10 cuts at 2.0 each		20.00
Ten sets to turn at 0.15 each		1.50
Square shoulder to 8½-in. diam. x 3 3/8 in. length at 0.0072-in. feed and 80 sfm. -- 2 cuts at 12.5 each (Note -- use 6.0 in. diam. for calculation)		25.00
Two sets to square shoulder at 0.35		0.70
File diameter to fit holder		2.40
Burr 2 edges - 8½ in. and 2 edges -3½ in. = 23½ in. at 0.06		1.40
Set-up to mill— use special holder	15	
Mill slot - 3/4 x 1 3/4 x 8 1/4 in. long-- 4 in. cutter at 0.0072-in. feed and 8- sfm. - 8½ in. ÷ 1.56 in. (cutter approach) = 9.81 in. Four cuts at 21.4 each		85.60
Set for subsequent cuts = 3 at 0.55 each		1.65
Handling time -- in and out of holder and true up		1.70
Layout to drill and centerpunch 4 holes at 0.50		2.00
Set up drill press	5	
Spot 4 holes at 0.30 each		1.20
Drill 4 holes 3/8 x 7/8 in. deep at 0.80 each		3.20
Locate to spot four and drill four -- 8 holes at 0.10 each		0.80
Tap 4 holes -- 3/8 - 18 x 7/8 in. deep at 3.6 each		14.40
Handling time for drill and tap		1.00
Burr all edges and holes— 18 edges at 0.06 each plus 4 holes (both sides) at 0.10 each		1.88
Total	38	196.53 or 197

MACHINING CHART—LATHES AND MILLING MACHINES


Feed
Length of Cut
Milling Machine Feeds
Depth of Cut
Cut off
Width of Cut
Cutting Speeds
Brass 138
Machine Steel 80-96
Tool Steel 67
High Speed Steel 55
For Lathes
Use 0.0072 and 0.0087 feed and ⅛ cut on O.D. work
NOTE:- For knurling use 50% of regular turning speed with 0.004 feed
- Present speed of toolroom milling machines
- High - 438 rpm.
- Low - 294 rpm.
- Present speed of toolroom engine lathes
- High - 525 rpm.
- Low - 425 rpm.
Surface Speed
Diameter
Standard per Cut

THE MACHINING CHART, from which lathe and milling-machine standard times are set, is based on 70 unit-hour performance with a 5% tool-maintenance allowance, milling-machine speeds ranging from 294 to 438 rpm., and toolroom-lathe speeds from 425 to 525 rpm.

normal day's pay—in direct proportion to his effort.

The plan was set up on the basis of units of work, a unit being the normal output of one man in 1 min. Normal production would then be 60 units per hour, with a premium paid for output exceeding the normal in any daily period.

Times Based on Machines

Before the plan was put into effect, standard data sheets covering practically all toolroom operations were assembled from time studies of toolmakers working on actual jobs and from results of operations on trial pieces. Basing the data on what *our* machines and tools could do gave standards that were accurate for our shop, but not necessarily for any other. Standards should vary, just as shop facilities and products do.

Developing the data sheets, approximately fifty in number, required practically the full time of two men for one year. Establishing accurate data cannot be done overnight—it costs money and time, but trying to install an incentive plan without reliable standards brings about the same results as predicting production with a crystal ball or by reading tea leaves.

The standards cover all types of machining, layout and handling operations encountered in toolroom work. Among these are standards for all kinds of machine tools used in our toolroom, for operations such as laying out and centerpunching holes and for handling values of work into and out of machines. Handling standards for a milling-machine operation, for example, would include unit allowances for brushing out the vise, collet or chuck, for loading, running the table in and out after the cut and unloading the work. If another cut were to be made, an additional allowance, in this case 0.55 unit, would be given for setting the table to position by using the graduated dials.

Even for operations as simple and quick as indexing a dividing head, standards have been established. Indexing 1/6 turn is allowed 0.13 unit, ¼ turn 0.17 unit and ½ turn 0.21 unit.

Assembly operations, being so varied, have not been set up in standard data sheets, but are given unit allowances equal to 10% of the standard time for the related machine work. While setting this allowance is arbitrary, experience has shown it to be reasonable, even allowing a contingency for unexpected difficulties. Unusual conditions are given special consideration.

As some tool maintenance is always necessary for any job, standards have been given a 5 to 7% allowance to cover it. Likewise, an allowance for oiling and cleaning of machines has been added to setup and tear-down standard times.

Applying Standard Times

One requisite of a successful incentive plan on toolroom work is a capable toolmaker trained to apply standard times on operations he lays out for each job because only a person who knows how to make the tools can do the layout. Setting of

standard times is not more-or-less automatic as in production work, because toolroom jobs are not nearly so repetitive.

Except for occasional recurring jobs, practically every one may be considered individual, requiring it to be laid out in detail in separate operations, each of which is then timed from the data sheets. One standards man can lay out operations and set standard times for 15 to 20 toolmakers on new work and up to 30 when a large proportion is on repetitive work.

How To Apply Standards

The sample work sheet shows the operationing and applying of standard times for a punch holder for swaging dies. A total of ten data sheets were required to time the job.

A flat allowance of 10 units is made for instructions, studying the blueprint and drawing tools from the tool crib. Succeeding machine operations are timed from their respective data sheets.

For example, after roughing the block on a Do-All saw and facing in a lathe, the shank of the punch holder is turned down from 2½ to 1½ in. dia. over its length of 1½ in. By assuming a 0.0072-in. feed and an 80-sfpm. speed, the standard time can be selected from the "Machining Chart—Lathes and Milling Machines."

From a feed of 0.0072 in. (upper left of chart), a line is projected horizontally to 1.7 under length of cut, then vertically to 80 under surface speed, horizontally to the diameter of 2.1 in. (mean diameter in this case) and finally vertically down to 2.0 as standard per cut. Ten cuts at 2 units each allows 20 units for turning of the shank. Timing all operations, with setup and standard times separate, gives a total of 38 units for setup and 197 for actual operations.

Available data sheets cover nearly all cases. For the occasional nonstandard operation, an estimate is made only if it is a small part of the total time. When an unusual job in the form of engineering or development work has many operations for which no standard times have been set, the job is not put on standards but treated as day work and paid at day rate.

Ordinarily about 90% of our toolroom work is on standard, with an occasional week of 100%. At present, development and experimental work has brought it down to approximately 70%.

Does Toolroom Incentive Work?

Our unqualified answer to that must be, "Yes." Base rate for our toolmakers is kept as close as practical to the area rate. But over and above the base rate, the incentive pay has been averaging approximately 35% more.

But even with the increased pay to the toolmakers, the company has benefited by getting the work done quicker and more economically. The following comparisons on some repetitive jobs show clearly the possibilities for improvement with the application of standard times.

To make twelve taps required, before the incentive plan was installed, 1,626 min. at a working rate of 36 units per hour, as compared to standard time of 978 units.

Grinding angles on one hundred fifty 15° turning tools required, before incentive, 1,602 min. at a working rate of 18 units per hour, as compared to standard time of 476 units.

To make twenty-four 0.255-in. mandrels required, before incentive, 1,008 min. at a working rate of 27 units per hour, as compared to standard time of 458 units.

Records show that a total of 134 jobs before incentive required 421,988 min. Compared to total standard times of 181,782 units, computed at a normal rate of 60 units per hour, past performance of the toolmakers for this group of jobs was 25.8 units per hour.

These conditions have been corrected, the men are producing at 80 to 90 units per hour with direct benefit to themselves, and the company can tool new and recurring jobs with less overhead and capital expenditure.

ENGINE LATHE VALUES

DRILLING – MACHINE STEEL

DIAM. HOLE	DEPTH OF HOLE																
	¼	⅜	½	⅝	¾	⅞	1.0	1¼	1½	1¾	2.0	2¼	2½	2¾	3.0	3½	4.0
1/16	0.60	0.75	0.85	1.00	1.2	1.5	1.9	2.7	3.5	4.3	5.1	5.8	6.6	7.4	8.8	11.0	13.5
⅛	0.35	0.45	0.55	0.65	0.75	0.95	1.2	1.7	2.2	2.7	3.2	3.7	4.1	4.6	5.5	7.2	9.2
3/16 to ⅜	0.30	0.40	0.50	0.60	0.70	0.80	1.0	1.5	1.9	2.3	2.8	3.1	3.4	3.8	5.0	6.8	8.8
½	0.35	0.50	0.60	0.75	0.90	1.0	1.3	1.8	2.3	2.8	3.3	3.9	4.3	4.7	6.0	7.8	9.8
⅝	0.70	1.0	1.3	1.5	1.7	1.9	2.2	3.0	4.0	5.0	6.0	7.2	8.4	9.6	10.8	13.4	16.0
¾	0.80	1.1	1.4	1.6	1.8	2.0	2.4	3.2	4.2	5.2	6.2	7.4	8.6	9.8	11.0	13.6	16.2
⅞	0.90	1.2	1.5	1.7	1.9	2.2	2.6	3.4	4.4	5.4	6.4	7.6	8.8	10.0	11.2	13.8	16.4
1.0	1.3	1.8	2.2	2.5	2.8	3.2	3.6	4.5	5.5	6.5	7.5	8.6	9.8	11.2	12.4	15.0	17.6
1⅛	1.5	2.0	2.4	2.7	3.0	3.4	3.7	4.7	5.7	6.7	7.7	8.8	10.0	11.4	12.7	15.3	17.8
1¼	1.7	2.2	2.6	2.9	3.2	3.6	4.0	5.0	6.0	7.0	8.0	9.0	10.2	11.7	13.0	15.6	18.0

For brass: *Use 50% of machine-steel values*

For tool steel: *Add 25% to machine-steel values*

THE STANDARD TIME for lathe drilling of machine steel can be selected from this chart. For a ⅜-in. hole, ⅞ in. deep, the standard is found to be 0.80 unit

HAND TAPPING

MACHINE STEEL

TAP SIZE	DEPTH OF HOLE		
	½	¾	1.0
7/16–14	2.5	3.3	4.0
⅜–18	2.3	3.0	3.6
⅜–24	2.0	2.5	3.0
¼–30	1.5	1.8	2.0
3/16–32	2.0	2.5	3.0

ADD 25% FOR TOOL STEEL

Load and unload vise

Light work	1-2 lb	0.25
Medium "	5-10 "	0.40
Heavy "	15-25 "	0.70

TAPPING a ⅜-18 hole, ⅞ in. deep, requires 3.6 units, giving a total of 14.4 for four holes, as shown on the work sheet. For work requiring holding in a vise, an additional handling time is allowed, according to weight of work

Should the Foreman Help Buy?

BY ROBERT J. SPENCE

A foreman receives a strange machine and learns what is involved in buying equipment. His study shows what your foremen can do to help in purchasing

AS FOREMAN, I recently went to the production engineer and submitted a formal requisition for a new machine for my department. I explained that the old machine was giving unsatisfactory service because it was worn out and requested a machine of the same make, but of a later model. The machine was one with whose operation my assistant and I were familiar, and several men in the department could operate it.

Some weeks later a new machine arrived—entirely different in make, type, size and capacity from the one requested. It was a kind which neither I nor anyone in the department had ever seen before.

Upset because I felt I had been slighted in the selection and had lost face in my department, I went to the production engineer and asked why I had been left out. He replied that in his experience the majority of foremen recommend a machine with which they themselves are familiar, but buying new equipment goes beyond the mere honoring of foremen's requisitions and includes things outside the foremen's knowledge.

Study New Machines

Determined to find out what is involved in equipment selection, I studied the matter and found the question of equipment selection stands at the top in management's aim to get maximum results in production with a minimum expenditure in effort, time and resources.

This aim involves study and systematic classification of the most recent developments in design and efficiency of many machines. Management must consider the problems of the newest cutting tools and the most effective tooling methods, go into the possibility of reaching satisfactory results by more intelligent use of present equipment, question the initial and carrying costs of a new machine in their relation to the profits to be expected from the work on hand, and know almost to a certainty if the material in process or in prospect will justify a purchase.

These are all major items of knowledge involving details such as: What is the quantity of work? What are the operations? What are the stipulated tolerances and quality of finish? What is the fixed time for completing the work? What about the incoming materials, their delivery date and quantity? Can needed accessories and devices from outside manufacturers be depended upon? What about the method of manufacture, as to hand tools, general purpose machinery, single-purpose, semi-automatic or fully automatic machinery?

The potential production with each of these methods must be determined and the unit cost by each method. In this unit cost must be embodied the labor cost, material cost, space cost, carrying cost, time element and degree of accuracy required.

In my search for information, I came to learn that the production engineer's staff had investigated my department, through the planning department, to see if my machines were producing to capacity; they had considered the running overtime of several of the machines; and they had gotten bids on the work from outside firms to see whether or not a purchase of a new machine was justified.

Foremen Can Help

The factors which enter into the purchase of a new machine are many and much of the data is beyond reach of the foreman, but I came to the conclusion that there are certain things which a foreman can do to assist in the buying of equipment for his own department and which he should do if he wants to have a say as to what comes into his department.

The foreman can establish convincing data which can be advanced with certainty in both recommending or refusing new equipment. The chief element, and the one upon which he can place most reliance, is the certainty that his machines are being run to best advantage. Knowing what the capacity of the department should be, and running it to that capacity, brings into play almost all the individual abilities of a foreman. Most firms recognize such high ability and are ready to listen to the man who has it.

To put himself into a more advantageous position to speak for the type of machines he wants, and to be helpful to the firm in so doing, the foreman can make it his business to learn just what the latest developments are in the kind of machine he needs. He can read articles in current technical magazines, study their equipment advertisements, get machine-tool catalogs, send sketches of work to machine-tool manufacturers to get production estimates on the work, and talk with local or district sales representatives.

It should also be of help to the foreman to establish a basis for furnishing a close approximation to production costs, and other costs which are not so apparent, to make his advice all the more authoritative. Using his personal knowledge of production output, plus the production estimates he has obtained from outside aids, plus information from the cost department on the method of quickly arriving at an estimate of costs, he will find that he can make as close an estimation of the unit cost as anyone.

Naturally, final decision as to the purchase of new equipment rests with higher management, and the answer to buy or not to buy may be affected by reasons of markets, shipping facilities or competitive prices, all of which may be beyond the foreman's knowledge. But nevertheless, the foreman can and should put himself in a position in which he can help in the selection of equipment.

ROUND TABLE

Should You Move Men Up Or In?

"Say, Ed, when are you going to pick up somebody to take care of those new machines I've got coming? Here I'm about to get new machinery in, and none of your men can get it running for me. What good is it, if your men can't figure out what to do with it? Let's hire somebody from outside who knows these machines!"

"Take it easy now, Al. That new stuff isn't due to run for another ten days, and by that time our gang will be able to keep it going for you. I don't like that crack about getting in an outsider, either. My men can handle anything that'll run. They all served their apprenticeships here and were brought up right."

"Sometimes I think that you overdo that apprenticeship stuff, Ed. I know your men are all right, but it might be good for this place to get some new blood in once in a while. New ideas, some competition. For instance, these new screw machines need a man who. . ."

"There you go again, always talking about new blood in the plant! Why, for 25 years, we've gotten by in good shape, trained all our own people, moved men up the line. Why upset something that's been working just because you're afraid? Our boys have to work with what we've got. Doesn't do us any good to get strangers to learn what we already know."

"Well, don't take it so hard. You'd think we were trying to replace *you*. All I meant was to scout around once in a while to make sure we're not getting into a rut. Seems to me we're building a wall around ourselves, thinking that we are the only ones who know anything. Now, on those new screw machines, if we . . ."

"Forget it, Al. You know as well as I do that floaters don't help. And as soon as we let them start coming in, there's no stopping them. Then what happens to our regulars? No sir, I'm all for developing our own people. We don't have to hire any temporary experts to help us."

"You're hard to talk to, Ed, because you're afraid somebody is going to come in here and show us a few things we don't know. Then we're going to start holing up in our shells again. The company needs new talent, new ideas all the time to keep ahead of the competition."

"You fellows who talk about new blood sure cover a lot of ground. Why don't you stick to one thing and prove that? The only way to be real about this proposition is to admit that if you want something done, want to build up a good crew of men, you do it yourself with your own people. You wouldn't like it so well here yourself if we didn't."

"O.K., Ed, O.K. All I wanted to say was that if we're not careful, we'll be losing out because we're afraid to look outside once in a while."

***SHOULD A NEW PROBLEM** be handled by men who are new too—men with special knowledge of that problem—or is it better to pick a trusted man and let him break in on the job? Your opinions and experience will interest others. Discussions of earlier topics appear on later pages.*

Practical Ideas

Direct-Reading Indicator Measures Concave Or Convex Radii

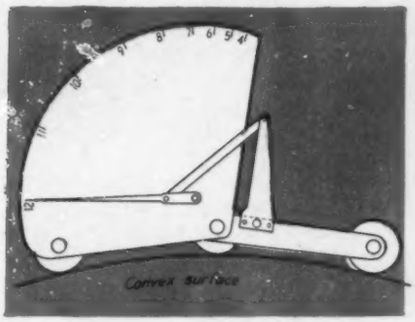
DONALD CAMPBELL
Cincinnati, Ohio

Often there is occasion to find the radius or the degree of curvature of short circular arcs in many kinds of work. There are many geometrical ways of calculating this algebraically from some known measurement, and of course, careful geometrical construction will also give the answer.

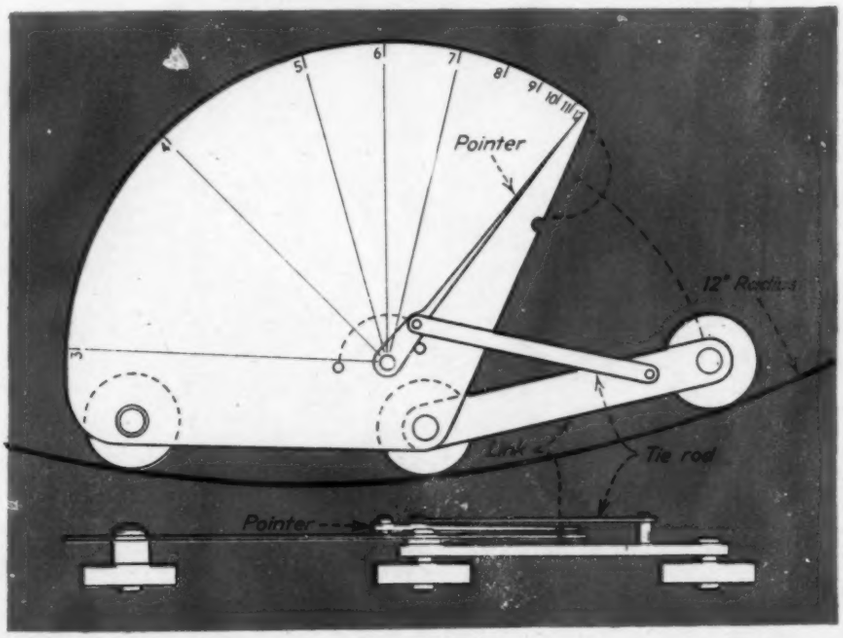
Here is a simple instrument that doesn't take long to make when precision tools are available. The model shown has been designed to read directly the radii of arcs from 3 to 12 in. radius with the greatest accuracy at the low end of the scale. Between 3 and 4 the graduations can be to 0.005 in. but between 11 and 12, they are only 0.05 in. apart.

The instrument consists of a protractor having about 120° included angle and carrying toolmaker's buttons or ball bearings at the vertex and at one end of its arc. Also at the vertex is a pair of pivoted arms or links which carry a third button at the same distance from the vertex as the other peripheral button. These arms can swing about 45° but because of a magnifying action, the pointer has been adjusted to travel 120°. When the instrument is placed along the inside of an arc, the three buttons all become tangent to that arc and the radius of the arc is indicated directly.

In addition to the obvious possibility of making the instrument in any size, any one unit, such as this one, can have its range greatly extended by changing pointers and tierods. The 6-in. base line (2 3-in. chords) seems about right for most machine-shop work and also for checking curves on maps and industrial plans, and in checking actual installations, such as curvature in pipelines, conveyor rails and dolly rails. Some surfaces may be concave but then others may be convex where the center is inaccessible entirely, as in the sketch above.



Substitution of parts converts the basic instrument for many other jobs



Simple mechanical construction from odds and ends makes possible the measurement of short arcs of widely differing radii without any regard for the center, which may very well be inaccessible or imaginary

Old Saws Make Crush-form Masters

O. FREDERICK NELSON

When standard radii have to be ground fairly often, and some form tool work is encountered or contemplated, one easy solution is a set of master crush-rollers made from well-worn high-speed saws or milling cutters. Instead of using brand-new grinding wheels, take some old ones that are worn to the point of scrap.

With the grinding wheel mounted on its spindle and the master roller on a hand crank fixture fastened to the table, feed the master into the stationary wheel and turn the crank.

This method can be applied to concave, convex, angles and steps that occur in form grinding.

Advantages are as follows:

1. No re-dressing of wheel for each radius desired.

2. Use of wheels that are con-

sidered to be fit only for scrapping.

3. Elimination of wasteful redressing of good wheels for each new job that comes along.

4. No lost time in dressing for regrinds.

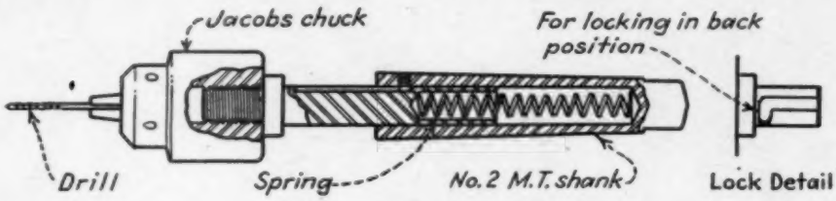
5. Wheels can be crushed from a master high-speed steel roller in a very short time.

6. Accumulated stock of various masters and wheels saves time when a job must be repeated later.

A temporary handle can be readily attached to the grinding fixture for turning crush roller.

Grinding wheels of medium or fine grit are recommended for best results.

After completion of grinding operation wheel and crusher are tagged and stored for future use.



Steady, light pressure from the internal spring assures perfect drilling with the smallest drills

Spring-Shank Chuck Gives Uniform Feed

CHARLES KIDWELL
Wichita, Kansas

We have found that a telescoping long shank with a light compression spring is a valuable aid in feeding small drills, taps and reamers when using the lathe tailstock chuck.

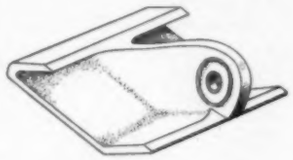
The straight shank on the chuck itself is tubular, and has a slot running along each side to engage a pin driven through the solid spindle mounted on the standard taper shank. A bayonet lock is added to hold the chuck "cocked" for changing tools and adjusting the setup.

Hex-Body Collet Chuck

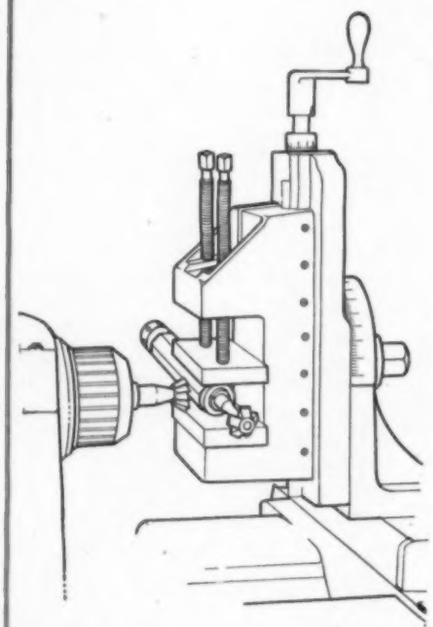
C. M. HUNTLEY
Seattle, Washington

Our repair and maintenance shop doesn't have a milling machine, but occasionally we get jobs just a little beyond our regular capacity.

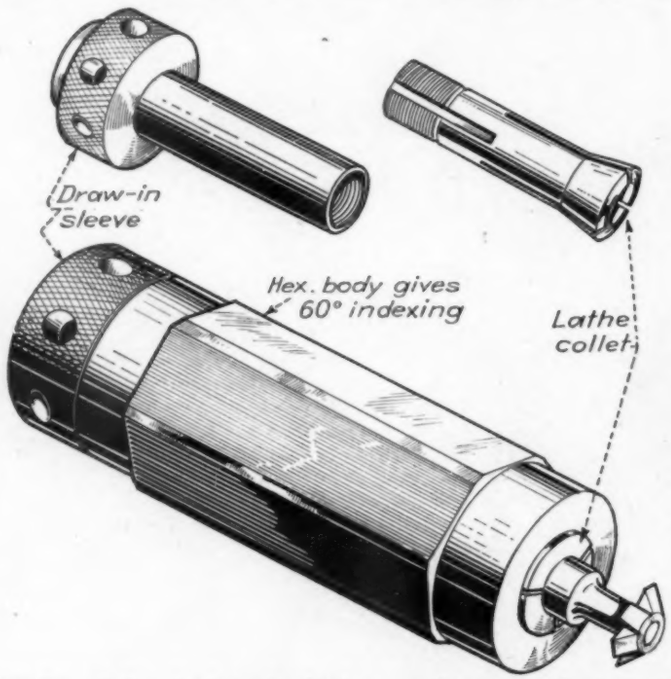
One tool that has extended and improved our lathe milling facilities is a collet holder made from hexagon bar stock. Taking the standard lathe draw-in collets, it can lock and hold any work, permitting 60°-indexing for the full revolution.



This idea originated when we had to make some special-thread taps, but it has since saved us many hours by making special cutters of various kinds in a very short time, and repairing or replacing parts that weren't in stock and might have taken weeks to get.



Special milling cutters can be made with this collet holder and a standard lathe milling attachment. To index, turn the whole collet chuck

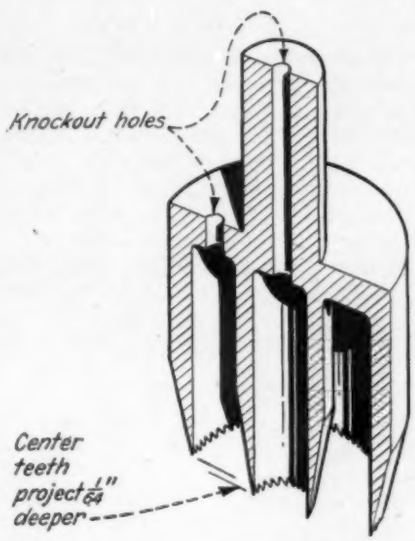


Construction of the chuck is simple: bore and taper the body to fit the lathe collets and make a shorter edition of the standard draw tube. Knurling and pin holes facilitates assembly. Aircraft part, top center, is an example of the emergency work performed with this fixture

Rubber Washer Cutter

PAUL E. WASSER
Kankakee, Ill.

A job recently came into our shop which called for rubber washers of non-standard dimensions, so to properly complete this job it was necessary for me to improvise a means of making these washers as they could not be procured.



Rotary cutting section makes cleaner washers than straight punching

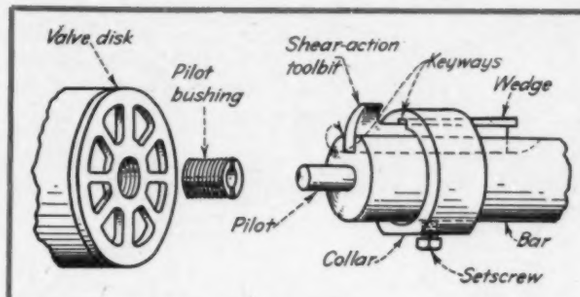
The washers had to be ¼ in. thick with an outside diameter of 1 3/16 in. and a hole in the center 17/32 in. in diameter.

The material I used for the tool was cold-rolled steel, 1⅝ in. O. D., 3 in. long. After turning, teeth were filed into the cutting edges with a small three-cornered file.

This cutter can be made with dimensions to suit any job. It was not hardened but it could be for longer life. Approximately 1000 washers have been cut and it still shows no sign of wear.

Any good coolant may be applied to the surface of the rubber before cutting begins. In my case, brake fluid was used.

In cutting washers of very soft rubber it would be necessary to clamp the rubber in the area surrounding the cutter to prevent twisting. This cutter works better than an ordinary punch and the finished product has a much cleaner edge. With hardening, this cutter could be used in cutting washers of slightly harder materials than rubber.



A threaded pilot bushing guides the shear-action, built-up facing tool

Deep Facer Dresses Valve Seats In Place

MARTIN H. BALL
Watervliet, N. Y.

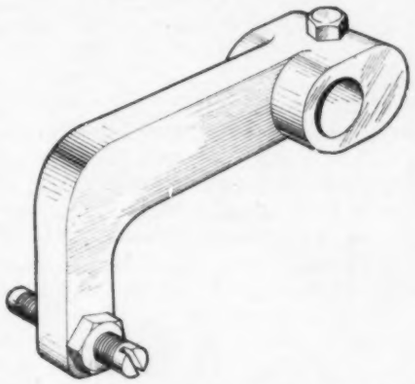
Here is a tool made for facing valve seats in deep chambers on a pump. The seats could not be removed without breaking them so it was decided to reface them in place, which was successfully done with this tool.

The seats were already threaded in the center, so a bushing was made to screw into this hole to make a bearing for the tool pilot. The holder was made of a piece of cold-rolled shafting with a shank turned on its upper end to fit a drillpress spindle and bored on the lower end for a pin. A keyway was cut in the collar and also in the holder. With the cutter in place, the wedge was crowded in snug and the setscrew set up tight; this action brought the collar down firmly on the wedge and cutter, holding them firmly in place.

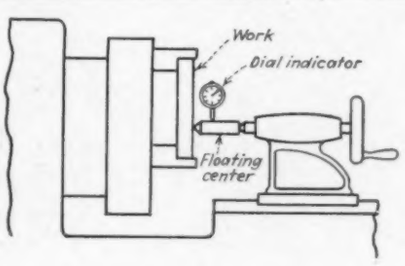
The cutting end of the cutter was made curved sufficiently to make its bearing on the valve seat of as near equal area as possible at all points of rotation, thus easing it on and off the bridge walls and also giving it a drawing shear cut, which is one of the most successful ways of preventing chatter. The pin was made a separate piece instead of a part of the holder so that pins of other sizes and different cutters might be used for other jobs. The principle of the curved cutter can be adapted in many other instances.

Adjusting Cranks — In using the swing stop on a Brown & Sharpe automatic it is always necessary to loosen the clamp screw and tap the arm over with a hammer to make an adjustment; most of the time this clamp sticks and when you do jar it loose, you have no control over the distance you moved it. I have taken the arm and drilled and tapped it and have added a nut for tightening and locking the screw. Now, when you wish to make an adjustment, all you do is loosen the nut and turn the screw whatever distance you may require. This has resulted in an easier way of making an adjustment and you can control it with ease. This increased our production 5% on #3 G. machines.

Steve B. Lake, Jr., Bridgeport, Conn.



Drilling and tapping the end of the swing stop permits a screw stop to be inserted, avoids difficult adjustment

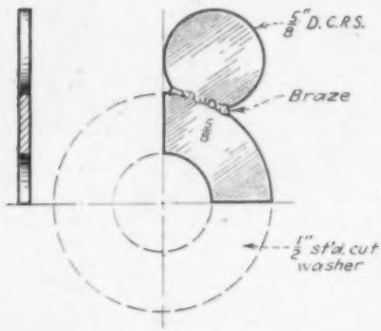


Indicating Disks—When the periphery is inaccessible for dial indicating because of chuck jaws or irregular outline, a floating center set between the desired center on the piece and the tailstock center will wobble and an indicator against the floating center will show the eccentricity. *H. Landauer, Tampa, Florida.*

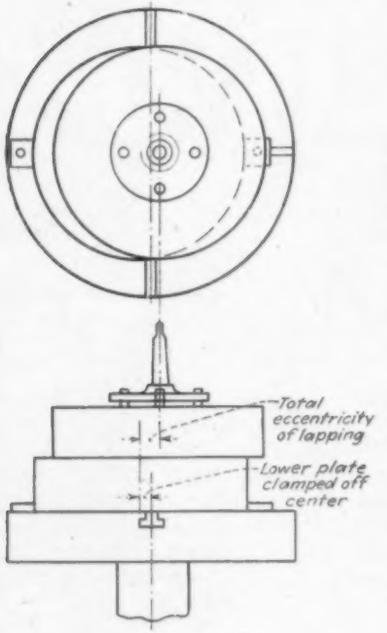
Hints on Small Tools

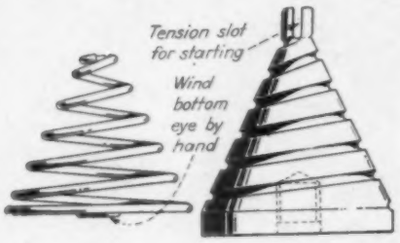
EARL R. GODDARD

Radius Gage—Onto a ½-in. cut washer was brazed a disk of ⅝-in. round cold-rolled steel, the faces smoothed, the size stamped, the washer chucked and bored to ⅝ in. and a quarter section cut out. This made a fairly good inside and outside radius gage, especially useful for large or special radii.

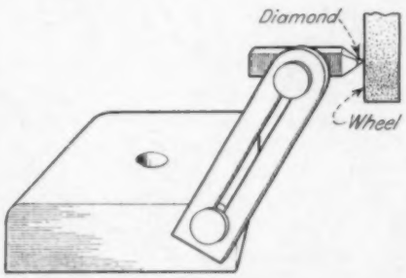


Eccentric Grinding—Grinding in some 14-in. diameter cast-iron rotary valve faces using this method proved to be very satisfactory. Previously, these seats had been ground with one seat rotated directly over the other one. This did not work as the faces ground faster at one point than another, resulting in faces that were not flat and leaked. Everything in the new setup has an eccentric motion and if the table is not too close a fit, this grinding will actually turn the table. If it does not, the table should be turned by hand a little every few seconds. Medium emery paste was used.



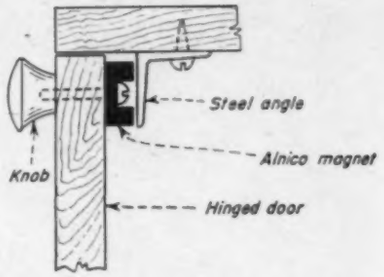


Pump Valve Spring Winders—Various shapes, styles and sizes of coil springs can be wound easily with arbors to cover the types and sizes used. Brass spring wire will wind close around diameter D and as a start, should be turned about the same size as the valve stud. The wire will spring open considerably on the last turn so the arbor angle should be at least 5° less than that of desired spring.

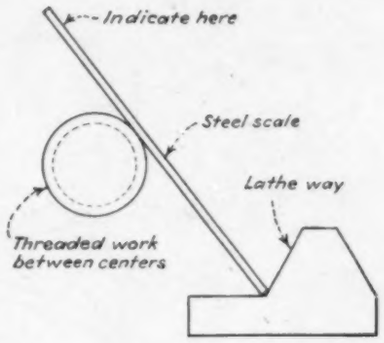


Diamond Holder—Here is a dressing tool equally adapted to high, and low, thin jobs. Knurled screws permit fast adjustments and the base will mount on magnetic or non-magnetic tables. Its versatility will save time in hunting for special blocks or in traversing the wheel over long distances. *Arnold F. Dyck, Port Credit, Ontario.*

Removing Dents — Dented and buckled sheet metal and pipe can be straightened as follows. A spot in the bulged metal is brought to a red heat which causes this spot to expand. Then by means of a press or weights this spot should be put under pressure and the spot allowed to cool down. As the metal contracts there will be a tendency to draw the buckle out. *W. E. Warner, Essex. England.*



Magnetic Catch—Cabinets, drawers, etc. can easily be provided with the simplest and most reliable of catches by simply installing a small Alnico magnet behind the knob so it will match with a small piece of iron on the fixed part of the cabinet. These magnets have holding capacity about double their own weight when well designed. *John Vasquez, Hartford, Conn.*



Indicating Long Screws — When a distorted threaded shaft, such as a leadscrew, has to be straightened, the common practice of making a bushing whose OD and ID are concentric, and slipping it over the threaded portion and indicating the bushing involves time and labor. This practice also contributes to the needless use of material as a separate bushing is required for each different diameter involved. A much simpler way is to lay a steel scale across the piece as shown, one end of the scale being supported by the ways of the lathe. By indicating on the free end of the scale, the untrueness of the piece is greatly magnified.—*Makoto Kimura, Seattle, Wash.*

More Index Holes—Most index plates have room enough for an extra ring of holes right next to the sector arm circle whenever the standard combination proves inadequate. *Joseph J. Urello, Bethlehem, Pa.*

Air Cylinders Improve Milling Machine Fixture

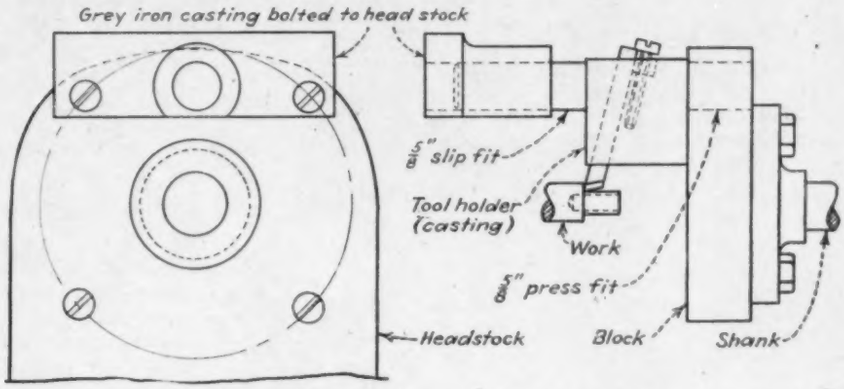
J. EARL SPELLMAN
West Chester, Pennsylvania

With the purchase of a large duplex milling machine, bought for the purpose of milling the top and bottom of our cylinder blocks at the same time, it was necessary to build a new machining fixture. Having used small air clamps very successfully on smaller jigs and fixtures throughout the plant, it was decided to try and make our new large fixture completely automatic by the use of air clamping devices.

After locating the block on foundry-ground targets, it was necessary to arrange our air clamps to insure positive clamping. By using small air clamps, with the proper leverage, we obtained holding strength of approximately 8,000 lb. per clamp on a 100-psi. line.

One valve, with a bleeder, furnishes quick action clamping and unclamping and reduces manual time to the very minimum. An electric air switch serves as a safety device to stop the machine immediately in case anything should happen to the air supply before damaging work or machine.

The new fixture and machine are making possible a 200% saving in time over old method of doing the job.



Overarm on turret tool rigidly aligns tool permitting accurate turning on long sleeves

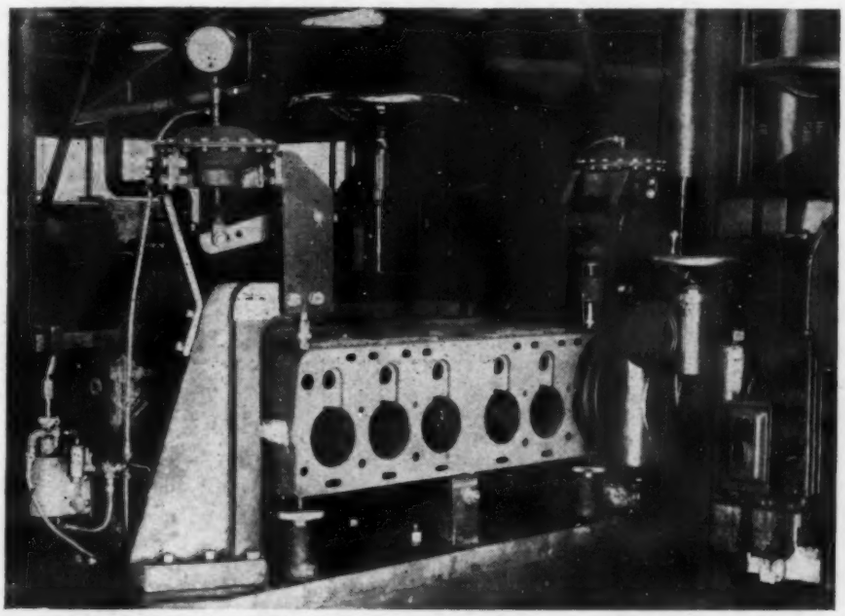
Guide Puts Accuracy Into Plastic Bushing Production

DONALD A. BAKER
Boonton, N. J.

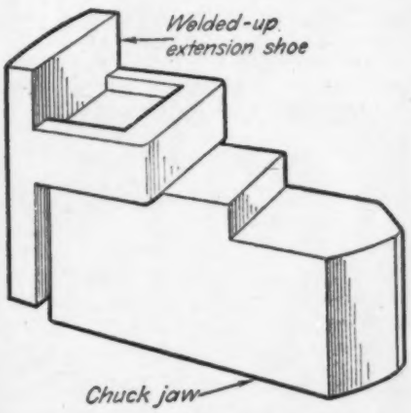
It is usually difficult to do accurate turning on light, hand screw machines with the turret tools, unless roller or box tools are used, which do not depend on turret-rigidity and alignment. But box tools can't be used to turn thin-walled bushings, especially when the material is Lucite or similar, because the follower would tend to crush the tube.

We solved this problem with a sort of a telescoping overarm bracketed to the headstock. The Logan lathe had four holes tapped into the headstock to hold a ball-bearing retaining plate, so, using the top two of these we bolted on a cast iron bracket which had a ⅝-in. guide hole directly above and parallel to the lathe spindle axis. The toolholder was another casting with one end made to slide in the ⅝-in. hole as the tool was fed along. The other end was press-fitted to a block bolted to the taper shank which fitted the turret.

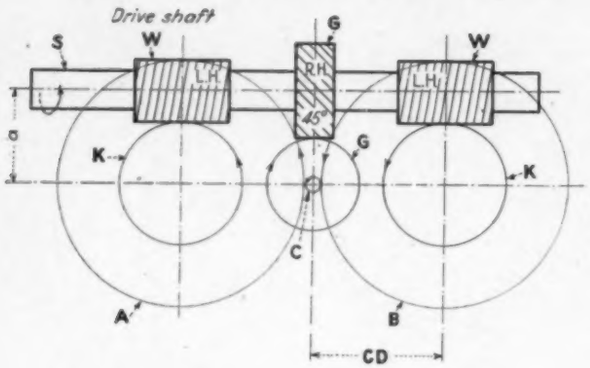
Tool infeed and adjustment is achieved with a large-headed screw which bears on the end of the toolbit.



Clamping force of 8000 lb. was achieved on each end of the work casting using small, 100-psi. clamps and suitable leverages



Chuck Yokes—Maximum chucking diameter can be extended to the full swing of the lathe, if necessary, by welding up strap yokes to hook over the jaws. Beyond a certain diameter, chuck jaws extend too far from their scrolls for security, but the yokes not only put the jaws back where they get a full grip but also permit greater swing because the clamping finger is much thinner than the jaw step ordinarily used. *M. L. Lowrey, Livermore, California.*



Large rools A and small roll C are maintained at same surface feed while center distance is varied to suit stock

Adjustable Centers Roll Drive Maintains Constant Surface Feed

E. J. HILLS
Rock Island, Quebec, Canada

We had to make a 3-roll drive for a special machine. The center small diameter roll runs in fixed bearings, arranged to accommodate rolls of various diameters. The two outer rolls are arranged in sliding bearings and are pressed against the inner roll by hydraulic cylinders or other suitable means.

All three rolls had to be geared together in such a way that the following conditions could be met: 1) The surface speed of the rolls had to be the same or, in other words, they had to run without slipping against each other. 2) The ratio of large roll diameter to center roll diameter had to be an integral multiple. 3) The drive had to be smooth with a minimum of backlash. 4) The drive had to be positive at all times. 5) The gears had to remain engaged while the outer rolls were moved away from the center, the movement being a maximum of ¼ in. 6) Variation of center distance between outer rolls, in order to simplify the design, had to be held within practical limits. 7) Changing the setup to accommodate center rolls having diameters ranging from 0.138 to 0.375 in. had to be provided for. It was desired to accomplish this easily and speedily.

This solution was selected from a number of layouts as the one best meeting the requirements. Referring to the diagram, drive shaft S, at right angles to the rolls, is mounted in split bearings and is arranged so that worms W can be slipped off to be exchanged with similar ones of different leads. Between the worms is a screw gear G, driving the center roll. The worms engage worm wheels K, driving the outer rolls. The screw gears have a ratio of one to one while the worm gearing is easily changed and can be cut to any of the ratios desired. At the same time the center distance can be maintained. Of course this means non-standard pitches and special tools to cut the worms and worm gears but this was taken into consideration and found a justifiable expense in view of the advantages gained. The outer rolls can be moved in and out without disengaging the drive, the worms being made with sufficient face.

As can be seen, the rolls can be geared to move at identical surface speeds, whether in contact or not. Thus they can accommodate material of varying thicknesses passing between them. As an example, say the center roll has a diameter of 0.138 in. while the diameter of the outer rolls was made 4.140 in., giving a ratio of 30:1.

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Twenty-sixth Selection—D. E. McDonald's V-Block for Thread Pitch

Allies Differ on Levels of German Metalworking Output

This first of two special reports on economic considerations facing metalworking industries in war-torn Germany indicates the scope of problems which must be ironed out by the Big Four before even equitable reparations can be agreed upon

BY JOHN CHRISTIE, BERLIN BUREAU, McGRAW-HILL WORLD NEWS

BERLIN—The condition of German machinery and metalworking industries offers a perfect example of the economic chaos and uncertainty prevailing in the Reich. These industries generally have been operating far below limits imposed by the 1949 level of industry plan.

Production cannot be increased materially until Germany is treated as a single economic unit. Even though economic unification may be achieved as a result of decisions taken by the Council of Foreign Ministers at Moscow, it may take several years before the critical shortages in basic raw materials, electric power and skilled labor are overcome sufficiently to enable the metalworking industries to attain the present prescribed levels.

The effect of reparations on these industries will be forthcoming only after several points are clarified at high levels. Reparations have had a negligible effect on the machinery and metalworking trades in the western zones thus far. The basic reason is that the U. S. and Britain have balked at removing productive capacity until the Russians and French decide to consider Germany as an economic whole. The Russians, on the other hand, have taken a relatively heavy toll of capital goods as reparations from these industries.

The future course of reparations depends on a number of factors. Economic unification is of fundamental importance because reparations must be considered in terms of traditional interdependence of the whole industrial system. To what extent, if any, the 1949 level-of-industry plan may be revised is another controlling factor. Reports prepared for the Moscow Conference by the various four-power committees, which have been wrestling with the problem of determining what productive capacity should be retained and what given up, indicate that the 1949 plan has a number of ambiguities and weaknesses.

The Allied Control Authority itself has power to revise the level of industry plan. Drastic or fundamental revisions, however, will be influenced by the broad political decisions taken at Moscow and succeeding conferences as to Germany's future economic status generally.

Adoption of a less-extreme definition of what constitutes "war potential," for example, would result in many fundamental changes in the plan. Of more immediate concern is the demand Russia is prepared to make for reparations out of current production. Any agreement along these lines would force at least compensatory upward revision of the 1949 levels affected.

Readjustment and settlement of reparations and levels of industry cannot come at once. Both matters are too complex for quick solution. The best that can be hoped for is that the four powers will agree on a basis for resolving the many controversial issues involved over the next few years.

Production Operations

Limited output of iron and steel (See Ruhr production chart), attributed in large measure to the coal shortage, has forced a quota basis on machinery and metalworking industries in the western zones. Top priority has been given to repair of rolling stock and locomotives, production of mining and agricultural machinery, food-processing equipment, and a few other industries vital to Germany's struggling economy.

Under the circumstances, plants making precision, medical and optical instruments and other equipment involving high expenditure of labor and low material needs have fared relatively well and have provided some much needed exports.

As neighboring European countries progress in reconstruction, they reveal their former dependence on German industry to an increasing extent. European manufacturers with German equipment are feeling the pinch of not being able to get replacement parts. Thus far, shipment of spares to other countries generally has been limited to items in stock. Also, there is an increasing volume of queries as to the possibility of ordering new equipment.

A number of large concerns in the Ruhr have on hand partially completed domestic and foreign orders for industrial equipment which were placed before or during the war. The Demag works in Duisburg, for example, has 10 rolling mills in various stages of completion up to 90%. The plant is now completing one of the orders destined for Italy. In many instances, raw materials for completing such orders in Ruhr factories are on hand but the required power cannot be afforded or some other factor prevents inclusion in British military government's production schedules.

Promotion of Exports

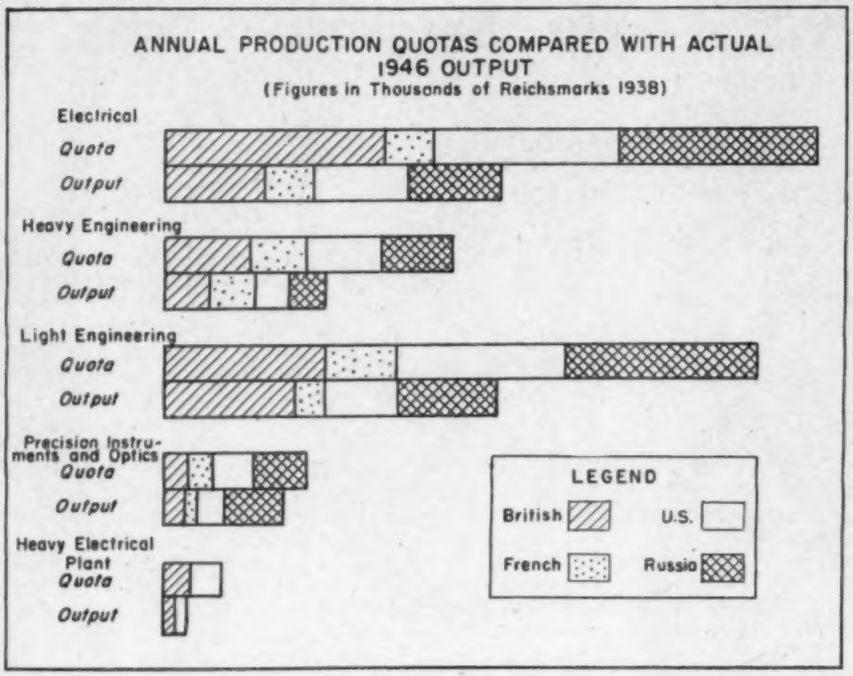
Meanwhile, the economic merger of the U. S. and British zones holds promise that more emphasis will be placed on promoting exports because the new partnership is founded on the common need for relieving the taxpayers of both countries of the present heavy burden of German relief expenditures. More exports are urgently needed in the first instance to pay for critical imports required for pump-priming purposes.

In keeping with the new export policy, the way has been paved for more businessmen to visit the combined zones.

Production of most types of industrial equipment is higher in the Soviet zone than in western Germany but a large part of it has been going for reparations. Although at the recent Leipzig Fair many eastern zone plants were authorized by the Soviet administration to make a bid for export business, delivery in most cases could not be promised under a year. Some plants had definite reparations commitments to complete first. All faced uncertainty as to availability of raw materials, which in any appreciable volume must come from western Germany.

Present interzonal trade arrangements between east and west encompass little more than the bartering of critical basic items, as for example coal and steel for potatoes and chemicals, etc. This means the highly interdependent metalworking

A SPECIAL American Machinist FOREIGN REPORT



Quotas Versus Output—Difficulty in getting German production anywhere near the quotas set is reflected in this chart. The Russians appear to be more successful in obtaining production than the British and Americans. A severe German winter was a major factor in limiting the production in all zones

trades, particularly those located in the eastern zones, suffer from the restricted exchange of replacement parts for maintenance and of components for new production.

Ball-Bearing Industry

The ball-bearing industry offers an example of the complexity of Germany's production problems. The 1949 level of industry plan provides that the manufacture of ball and roller bearings shall be prohibited in Germany as soon as the country is in a position to meet requirements by importing. Until then, production for domestic needs only is permitted.

Ninety percent of Germany's output of bearings came from VKF and Kugelfischer, both located in the U. S. zone. VKF's plants at Schweinfurt and Cannstatt accounted for 58% of the production and Kugelfischer at Schweinfurt for the other 32%.

VKF's annual capacity in 1938 was 41,400,000 bearings and production was 36,000,000. Average daily output was 120,000 bearings and the rated daily capacity was 138,000. Maximum present capacity with existing plant facilities is estimated as follows:

Daily output on one-shift basis

Schweinfurt plant..	35,000	bearings
Cannstatt plant....	15,000	"
Total	50,000	"

Daily output on two-shift basis

Schweinfurt plant..	60,000	bearings
Cannstatt plant....	25,000	"
Total	85,000	"

Kugelfischer's capacity was 16 million bearings in 1938. Average daily production was 49,100 per day and the rated capacity was 53,000. Half of the plant has been shipped to Russia as reparations. Remaining plant facilities, provisionally earmarked for allocation among western nations, have maximum capacity at present as follows: 14,400 bearings daily on a one-shift basis; 24,000 bearings daily on a two-shift basis. Combined total capacity for all Germany in 1938 amounted to 58,071,000 bearings.

Total production in 1946 at the two plants was 13,283,000 bearings or 6,080 tons, representing 90% of the production for Germany. VKF made 8,140,856 bearings and Kugelfischer's output was 3,720,950 bearings.

Electrical Equipment

A large and important segment of the electrical industry has been engaged in primarily reconstructing its own production facilities. This has been particularly true in Berlin, where roughly 40% of the industry is concentrated and where the Russians took an exceptionally heavy reparations toll prior to four-power occupation of the city. AEG, Siemens, Telefunken and Lorenz were among the leading enterprises virtually stripped of productive capacity.

These firms have done a remarkable job of salvaging equipment and otherwise restoring their plants. Siemens-Hadske and Siemens-Schuckert, for example, are prepared to begin producing in modest volume a surprisingly wide range of industrial power and lighting equipment as soon as the coal situation improves. The two plants are now employing 10,000 each compared to a total of 50,000 before the war.

Electrical concerns in the western zones likewise have had difficult problems to overcome in reestablishing their production facilities. The Robert Bosch and AEG plants at Stuttgart, for example, have had to retrieve and reinstall hundreds of machines placed in wartime dispersal plants.

Small electric motors, transformers and hand tools have dominated the limited amount of new production of industrial-type equipment. Work on heavy industrial power units has been limited principally to repair and maintenance. Shortage of insulation materials of all types is the chief handicap to the electrical goods industries aside from inadequate coal and power.

Reparations

In the U. S. zone, half the Kugelfischer ball-bearing plant at Schweinfurt has been dismantled and shipped to Russia. The other half of the plant is still operating under special provision of the 1949 level of industry plan as explained previously. Kloeckner-Humboldt-Deutz, AG, of Oberusel, which made now prohibited large diesel engines such as were used in submarines, is another in the direct war potential category to be broken up. France and Belgium got the bulk of the 350 general purpose machines from this plant, while the remainder were divided among the United Kingdom, India, Albania, Luxembourg, Czechoslovakia and Yugoslavia.

Russia is giving to Poland the equipment being made available to her by the dismantling of the Fruehwald and Jaeger plant at Nuremberg, which prewar made hardware, automotive parts, some conveyor and food processing equipment and steel cabinets. The plant was valued at 1,215,163 RM. From the breaking up of the Hensoldt optical instruments plant at Herborn, 240 general purpose machines were made available for reparations and were allocated 88% to the Netherlands, 9% to the U. S. and 3% to France.

The great industrial Ruhr in the British zone thus far has yielded little of its productive capacity to reparations. The biggest enterprises outside the direct war production

category have been the Krupp works at Borbeck, valued at 27,661,445 RM, and the Bandeiswalzerke rolling mill at Dinslaken, valued at 18,166,445 RM, both of which have been allocated to Russia.

Only two metalworking plants have been taken. One is Haniel and Lueg of Dusseldorf, which made a number of types of machinery including equipment for the oil industry. Its general purpose equipment has been divided among Australia, United Kingdom, Greece, Norway, Czechoslovakia and Yugoslavia. The other is Kurbelwellenwerke, G.m.b.H., engine crankshaft plant at Glinde Reinbeck near Hamburg. Its machines have been allocated to France, Netherlands, Australia, Denmark, United Kingdom, Czechoslovakia and Yugoslavia.

Ball-bearing Production Halved—This photo was taken in the remaining half of the Kugelfischer ball-bearing plant at Schweinfurt and shows Germans turning out ball bearings in a restricted program. The other half of the plant was shipped to Russia as reparations. Ball and roller bearing production will be prohibited in Germany at a future date

Heavy Engineering Group

Most mining machinery and equipment such as compressors, pneumatic tools, pumps, engines, etc., are included in the "heavy engineering" group. The level of this group was fixed in the 1949 level-of-industry plan at 31% of the 1938 production levels. It was ruled later that in calculating retained capacity, this group should be placed on a double shift. This has resulted in a majority of reputable firms, which have been the backbone of the mining machinery and equipment industry for many years, being listed as surplus for reparations. To carry this out would make it clearly impossible to reach maximum output in coal mining as dictated in the plan.

In the steam and hydro turbine section of the mechanical engineering industry and in the electrical engineering industry, much weakened by removal of capital plant and equipment from leading works in Berlin, it is doubtful if sufficient capacity exists to meet the heavy demands for repair and upkeep of the older power stations which are being retained in Germany and for replacement of German power plants installed in other countries, particularly in Europe.

Many potential difficulties are attributable to the grouping of all mechanical and electrical engineering industries under the classifications: "heavy and light engineering" and "electrical engineering" and "heavy electrical plant." For example, the British cite the fact "heavy mining machinery" is listed under the heading "heavy engineering" but the plan carries no definition of what constitutes "heavy mining machinery" and makes no provision for "light mining machinery."

Included in the total for "heavy engineering" (1,394 million Reichmarks) is the complete line of pneumatic machinery from heavy compressors to light hand tools. The item "prime movers" includes engines of all sizes down to the smallest. Similarly meaningless is the item "light engineering" which actually includes excavating machines used for open cast mining.

Both American and British members have contended that levels have been set without proper consideration for replacement parts. They point out that listing of firms for retention has been made up on the theoretical basis of new production only.

The prescribed retention level for machine-tool manufacturing capacity is cited in particular as not making adequate provision for German internal and export requirements of replacement parts. Americans cite the need for more adequate provision for increased maintenance and equipment replacement in power plants which will be imposed by the proposed approximately 40% increase in the level for power-plant output in Germany. They also call attention to the need for "insuring

Battery Separators — A workman is shown in the Bosch plant at Stuttgart making lead separators for batteries. Bosch had to retrieve hundreds of its machines before it could resume operations. Russians removed considerable equipment

retention of sufficient sub-contracting capacities to support critical industries."

The French and Russians tend to feel that the means used to determine necessary capacities have given a distorted picture of German industrial potential and that of a considerable amount of productive capacity exists which has not been ascertained or taken into account.

French Delegation Views

The French delegation is of the opinion that, although certain levels may be considered insufficient, it must be maintained that the capacities actually being retained are on the whole far in excess of those necessary to achieve the allocated levels. Although there are no actual official figures to lend support to this opinion, it is based on the following:

1. The method of evaluating capacities by the figures of production in reichsmarks has inherent in it a fundamental error, considering that even in 1938 it could not be assumed that production figures were an exact reflection of capacity.

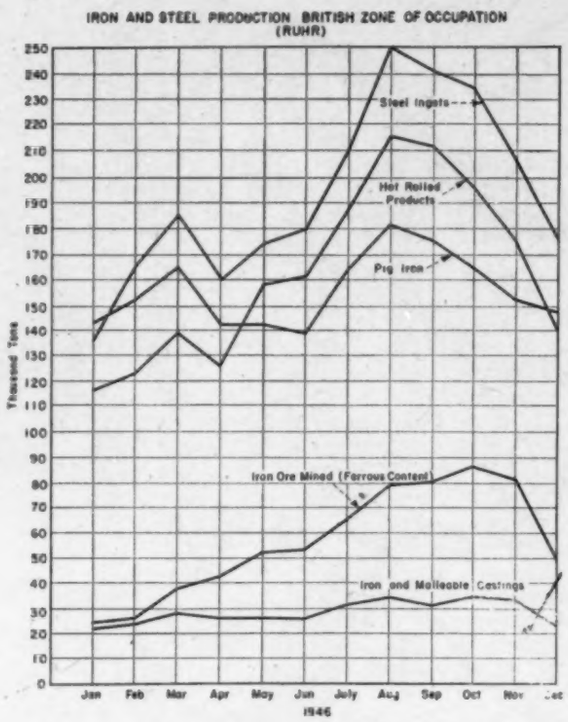
2. When retained capacities were established by the zones, in accordance with the prescribed method, it was impossible to obtain an exact idea of the equipment which the German manufacturers would be able to put into service again after repairing damages incurred. The number of machine tools put completely out of action now proves to be extremely small.

3. When the capacities were established, it is certain that there existed in German factories considerable bottlenecks owing to the destruction, and it is doubtful whether the possibility of remedying these has been considered sufficiently.

4. A preliminary study of the reports of the Inter Allied Commissions checking capacities seems to afford ample confirmation of these doubts, and in many branches of industry the capacities when checked, were found to be vastly superior to the capacities estimated (electricity, transport, precision instruments in particular).

5. The estimation of the capacities of factories making finished goods has certainly left out of account a very large number of sub-contracting factories which were very well developed in Germany, with the result that there are discrepancies between the latter and the factories manufacturing finished goods.

6. There is no doubt that, apart from the industries which have not been studied and the small factories which have still to be considered, there is still equipment which has not been revealed.


IRON AND STEEL PRODUCTION BRITISH ZONE OF OCCUPATION (RUHR)
Steel Ingots
Hot Rolled Products
Pig Iron
Iron Ore Mined (Ferrous Content)
Iron and Malleable Castings
Thousand Tons
Jan Feb Mar Apr May Jun July Aug Sep Oct Nov Dec
1946

The Future of Steel—The 1949 level of industry plan states the production capacity of the steel industry to be left in Germany should be 7.5 million ingot tons. This figure is subject to review if further reduction is held essential

In keeping with the French analysis of the situation is the Soviet observation: "There are considerable differences between production capacity which existed in Germany according to the German official statistics and that which is now shown as the total of the capacity retained in Germany within the approved level and the capacity to be declared surplus."

Plant Capacities in Error

The Soviets contend that "the largest plants which have modern equipment and the best experience in war production are being retained within the approved level." They claim that inspections by Inter Allied Commissions, made for the purpose of checking capacities listed for retention under the 1949 plan indicate that capacities of plants in western zones have been estimated and are from 30% to 100% in error.

The method of evaluating capacity has been criticized equally as strongly by the British. "The method of assessing for reparations," according to a committee report, "the production capacity of firms on the annual value of their sales may be quite misleading. Firms may purchase a high proportion of their assemblies and parts and have a high sales output with very little capital equipment so that sales output of reparations value may have little connection." The British have criticized introduction of double shift working to the heavy engineering and transportation industries for the purpose of calculating the number of plants to be retained. They also state the belief that considerable duplication of industrial returns has occurred in the German statistics on which the retained capacities are figured under the 1949 plan. For example, they point out that the value of an internal combustion engine might be reported in the internal combustion engine Fachgruppe statistics and again in the figures submitted by the hydraulic pump manufacturer to the pumps Fachgruppe.

Although 1936 and 1938 output admittedly is a difficult yardstick to use in determining what productive capacity should be retained in a given industry, an alternative is not easy to devise. Using employment has been suggested, but few believe this would be a more accurate reflection of productive capacity.

One reason for the classifications such as heavy and light engineering being so ambiguous is that when the plan was being drawn up the U. S. and British tended to favor more liberal levels than the other two powers and considerable juggling and compromising was done to save certain elements of industry from too severe reduction.

(Editor's note: The second part of this special report on the German metalworking situation will be presented in a forthcoming issue and will take up in detail specific industries such as automobile, truck, agricultural machinery, and locomotives and rolling stock.)

NEWS OF METALWORKING

11,000 Surplus Machine Tools Tagged For Military Reserves in Two Months

WASHINGTON — In two months JANMAT (Joint Army-Navy Machine Tools) has earmarked 11,000 surplus machine tools for military reserve, and has allocated 5,000 of them to Army-Navy branches that have requested reserves.

Still to be selected by JANMAT tagging teams are 26,000 tools for Air Forces; 12,500 for Army Ordnance; 500 for Chemical Corps; 26,000 for Navy BuAer; 1,200 for Navy Ordnance; 5,400 for Navy reserve personnel training; 935 for Navy BuShips, all heavy types; 50 for Office of Naval Research; 1,400 for Navy Yards and Docks.

Air Forces Acted Early

Prior to the JANMAT program, which was set up in accordance with a directive from reconversion chief John Steelman last Nov. 9 to the Secretaries of War and Navy and War Assets, Air Forces had already earmarked 17,000 tools on its own recognisance, and Army Ordnance had tagged and stored 7,000, over and above the machines in use in its permanent manufacturing arsenals and standby ordnance plants.

The total JANMAT program (outside of independent federal agency selections) probably will not add up to 80,000, as estimated by various sources. Program officials told AMERICAN MACHINIST the total will be nearer 70,000 pieces.

Higher Stockpile Sought

However, Army-Navy Munitions Board, which directs policy but not operations in the machine tool reserve program, has sent Congress a letter urging authorization for a national stockpile of machine tools and other productive equipment, which might total 250,000 items. This stockpiling would be from remaining surplus after all channels of disposition of War Assets and Defense Plant have been worked out. It would be administered by the Treasury.

Legislation is also pending to give the services in JANMAT program title (in addition to custody) of DPC tools. The services do not need title to those tools selected from WAA surplus; they simply withdrew them from surplus. Army and Navy try not to ship selections more than 500 miles to storage.

Critical Items Unavailable

War Assets has a list of tools in short supply, which are not supposed to be tagged for reserve. The object is to make equipment available for industry reconversion, especially where veterans are involved.

WAA, due to its scope and intricacy, cannot keep all of its invoices up to date, whereas the military branches know exactly where all their stuff is. The services hesitate to sell their reserve machines as they paid $400 apiece for storage and transportation costs.

There is a conflict of interest between the JANMAT reserves and tool-buying public. This conflict hinges squarely on price. War Asset's "fixed-price register" categories are all bargains, and so are the Clayton formula items, because the latter prices are based on prewar machine prices.

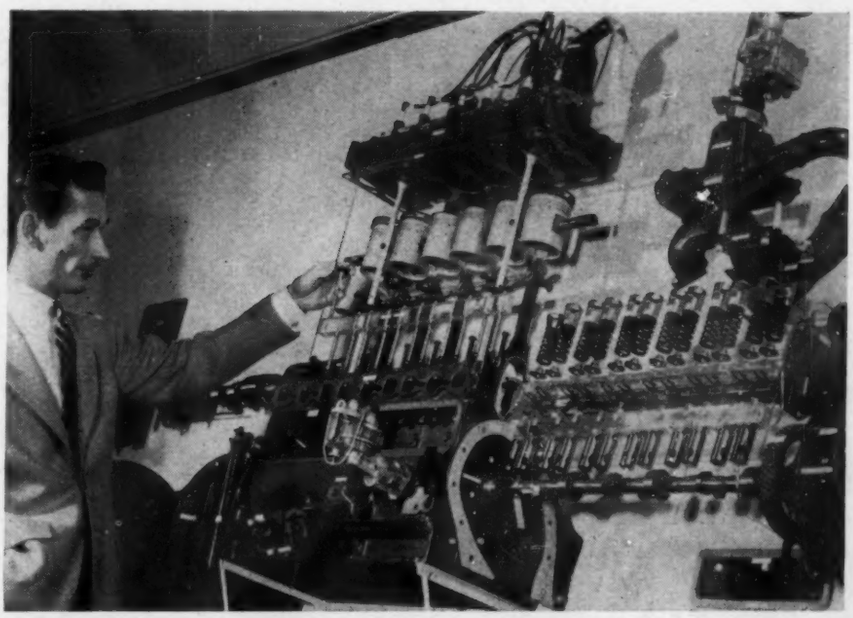
More Regions to be Added

JANMAT tagging teams, totaling about 100 men, each carrying the master list of the military requirements, are working over JANMAT's seven regions. These are Boston, New York, Philadelphia, Cleveland, Detroit, St. Louis, and Chicago. Six to eight more soon will be added.

Last December 4 the JANMAT control committee, with men from Navy, and from Army Ordnance, and from the Air Forces, was organized, with Mr. A. H. Millbourn, of Army Ordnance, as chairman. Tagging started Feb. 3, based on lists of requirements from 11 bureaus. By Feb. 18,951 tags had been turned in, and more batches of tags came in on March 4, March 11, March 25, and April 1, the high total being 1,834 on March 18. On March 31, the committee got the signal to screen tools in plants declared surplus to WAA (most of which contain DPC tools, a few tools owned directly by Army or Navy) and the tagging rate will go still higher.

Storage Considerations

AAF is storing all its reserve tools under two roofs: the Glenn Martin-Nebraska plant at Omaha, and the Bell Marietta plant in Georgia. Ordnance is storing in 30 places. Processing for storage is a hard problem. AAF has one method, WAA has one, Ordnance another. Grease, oil, cocoons, dehumidification of "cans" and rooms, are being tried. Navy is even running the machines once a week.



Exploded Auto—For display and training purposes, Studebaker has laid out and mounted all parts of the drive of an automobile chassis in correct relative position to show how an automobile works and how its components go together. A section of the 224 sq. ft. board is shown here with parts drawn in three directions from the block and mounted in transparent brackets

Gaging Business

No Slackening in Metalworking

Metalworking production stays at an all-time peak for peacetime, despite the slackening of operations in soft goods. Aside from machine tools, sales of which have been sluggish, demand for machinery and for all kinds of capital goods made in metalworking shops shows no signs of recession from previous high levels. In many lines, such as turbines, motors, textile machinery, woodworking machinery and household appliances, backlogs remain huge despite record production. Though workers are being laid off in some industries, the supply of men in metalworking is not excessive and shortages are still reported here and there.

Copper Is Tightest Material

Copper is the tightest of all materials. Chances are slim that the supply will ease the remainder of this year. Demand in this country for 1947 is estimated at 1,500,000 tons, whereas production domestically will not be more than 1,000,000 tons, if that much, and imports are not likely to exceed 300,000 tons. Thus a deficit of 200,000 tons is in prospect.

Lead, zinc, glass and lumber are among the materials which are more easily obtainable now than they were a few months ago. Aluminum still continues to give trouble. Electrical industry is using considerable amount of aluminum as substitute for copper in wire.

Steel Continues Critical

Steel is as critical as ever. This is especially true of flat-rolled products. For one thing, consumption of cold-rolled steel is so high that users who normally specify hot-rolled stock are experiencing difficulty in getting what they need. Some fabricators, in fact, complain that new capacity being installed this year in flat-rolled items is mostly in cold-rolled and will not help to relieve the pressure in hot-rolled products.

Some structural steel users say that they cannot get required tonnages to meet schedules. Structural and pipe mills are booked far into the future. Only softness in prices has been in waiving of extras, despite Washington's desire for a general reduction. Black market transactions appear to be lessening. Swapping of steel for motors and for other items continues in some cases.

Machine Tool Outlook Mixed

There is considerable cleavage of opinion in the machine tool industry regarding the outlook. Some builders are hard hit by the disinclination of many important buyers to place orders and to postpone major purchases into the indeterminate future. The result of the general decline in machine tool demand has been the ability in several standard tool items to secure machines out of stock for the first time in eight years. A certain segment of the machine tool industry is relatively optimistic about the volume of business ahead particularly from the automotive field, which has been uncommonly quiet for months. Export orders still are below expectations, with most sales consisting of single machines or two or three machines each. A limited amount of business has come out of Latin America lately, with European countries buying at a fair rate.

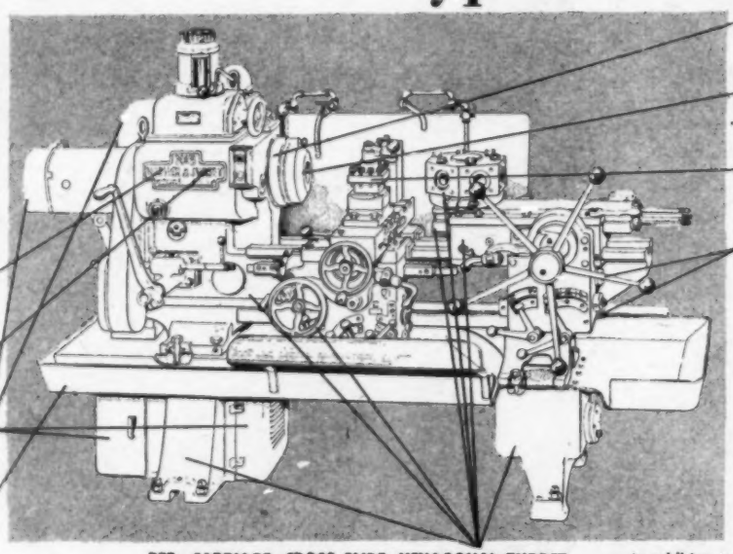
Car Assemblies High

Automotive production is holding up high. There appears no reason to doubt that assemblies will stay up around 100,000 units a week indefinitely. Some retail price resistance is being encountered in the higher-price brackets and among certain independent car lines, where models for quick delivery are available. There is no sign of a general trend in the automotive field toward lower price levels although this picture might change.

Employment in 69 aviation plants —airframes, engines, propellers, parts—is expected to rise to 250,000 by midyear, from 222,280 on January 1. A drop of 50% is anticipated, on the other hand, early in 1948.

Iron and Steel Used in Typical Turret Lathe

The turret lathe, a machine tool widely used by the American metalworking industry, contains more than 2000 parts. An analysis of the quantities of iron and steel purchased to produce an average turret lathe, according to a large manufacturer, is listed at lower right hand corner. The difference between the purchased weight of the steel and the finished weight of the lathe represents one of the sources of market scrap to be used by steel makers.



HEADSTOCK GEARS ..... ALLOY STEEL FORGINGS

HEADSTOCK SHAFTS ..... ALLOY STEEL BARS

GUARDS, HOUSINGS ..... CARBON STEEL SHEET

PAN ..... CARBON STEEL PLATE

SPINDLE ..... CARBON STEEL FORGINGS

COLLETS – ALLOY STEEL ..... BARS AND FORGINGS

SQUARE TURRET ..... CARBON STEEL FORGING

SHAFTS, LEVERS ..... CARBON STEEL BARS

BED, CARRIAGE, CROSS SLIDE, HEXAGONAL TURRET, TURRET SLIDE, SADDLE, APRONS, PEDESTAL — CAST IRON

IRON AND STEEL REQUIREMENTS

Cast iron	4200 lbs.
Sheet steel	583 lbs.
Carbon bars	1100 lbs.
Alloy bars	1150 lbs.
Steel plate	150 lbs.
Steel forgings – carbon	410 lbs.
Steel forgings – alloy	260 lbs.
Malleable and steel castings	203 lbs.
TOTAL	8056 lbs.

In addition to the above, iron and steel are used in motor and controls, ball and roller bearings, pumps and clutches. The average finished weight of one of these machines is about 5500 lbs.

PREPARED BY AMERICAN IRON AND STEEL INSTITUTE

Farm Machinery Makers Anticipate Best Production Year in History

CHICAGO — Unless labor troubles upset the apple cart, farm machinery makers will have their biggest production year in history this year, even larger than the wartime peak of $1 billion in 1944. Both J. I. Case and Allis-Chalmers are picking up rapidly after the ending of their strikes, and both will be producing at capacity soon. International Harvester's output is running at the highest peacetime rate in the company's history, and labor efficiency is improving.

The farm market for machines is continuing active in most lines, although there has been a slight slackening in demand for dairy equipment. Nevertheless, even milking machines and cream separators are selling quickly. And manufacturers point out that items that bulk largest on production schedules—tractors, combines, hay balers and corn pickers—are items for which the backlog of demand is largest. The products that are near a balance with demand are mostly the smaller, less expensive ones.

Full Output Set for May

J. I. Case expects to be in full production early in May. The company has had a difficult time in resuming production because the shutdown was so long. However, machinery was maintained in good condition, and the chief problem is to reschedule output to clear the plant of many partly completed products on which work stopped when the strike began.

The chief difficulty Allis-Chalmers has faced since the strike ended has been the tight labor market in Milwaukee. Before the Allis strike started a year ago, the company had 11,500 production workers at the West Allis works. When full production operations were resumed after the strike, the company got back only 7,200 workers. Allis expects, however, many others to return after giving notice to temporary employers. Meanwhile Allis is conducting a lively recruiting campaign.

Heavy Equipment Pushed

Allis' industrial machinery division is concentrating on the production of heavy equipment—such as cement, lumber and flour mill machines—because the manufacture of these lines was especially delayed by the strike. In the period when a partial force was working, output was concentrated on smaller units because of the unbalanced production force.

Another new plant that will add its output to that of the other farm equipment facilities this year is the John Deere tractor plant in Dubuque, Iowa.

ABNORMAL DEPRECIATION RECOGNIZED BY TAX COURT

WASHINGTON—As both users and sellers of depreciable machinery, the metalworking industry is interested in allowances for accelerated depreciation for tax purposes. Thus far the Bureau of Internal Revenue has denied all claims for accelerated depreciation on a plant-wide basis.

In rare cases the bureau has made a larger allowance for depreciation on certain machines where the taxpayer has shown conclusively that life of machines was shortened by intensified use. In no instance has the bureau granted larger allowance in claims based solely on statistics showing increased hours, multi-shift operation, and inexperienced operators.

But the Tax Court, a special court of appeal from decisions of the bureau, in recent memorandum opinions on three cases, has recognized validity of abnormal depreciation because of intensified use; has accepted over-all statistics as evidence of intensive use; has accepted company and outside expert testimony on depreciation; may allow accelerated depreciation on all productive facilities in a plant. The court is more liberal than the commission.

Record Steel Output Threatened By Coal, Price Developments

PITTSBURGH — Two unexpected developments have served to place the entire steel industry on edge and unless resolved within a relatively short time can affect profoundly the supply situation over the balance of this year.

The crisis in respect to prices and that which developed in coal were unforeseen. It had been expected that the April hurdle would be the labor negotiations with the United Steelworkers whose working contract is due to expire April 30.

The leading steel producer has attempted to quiet discussions of prices by stating such a matter cannot be considered prior to a new labor agreement with the USW.

Price Issue Overshadowed

Pressure from outside the industry has kept the price matter alive but it has been subordinated more recently to the developments in coal. Should the nation retain a belief that a price cut in steel is possible, demand can soften.

On the other hand, if the coal developments continue in a situation where a return to an economy of scarcity is indicated, supply can be whittled down to a point where there can be a return to the extreme tight conditions of 1946.

With the first wave of publicity in respect to the possibility of a price cut, there were some cancellations of orders. Not enough to disturb the bullish attitude which long has existed in the sales departments of steel companies, but the very fact that some consumers could afford to cancel some orders indicated that there could be a reasonably fast change in the steel picture to one of swifter deliveries.

Electronics Park—General Electric's Electronics Department is now completing construction of Electronics Park near Syracuse, N. Y., where receivers, transmitters and specialty products will be made. Park consists of 155 acres, of which 30 acres will be under roof. Maximum employment will be 5,000

Growing Signs of Labor Discontent May Be Offset Through Compromises

NEW YORK—Management's hopes for a strike-free year have received a rough jolt. Dark clouds gathering on the labor relations horizon threaten a stormy period ahead. They may blow over—but they may not.

▸ Strike idleness during the first quarter of 1947 showed a sharp decline from the corresponding period last year. Work stoppages during February numbered only 290 nationally, and involved 90,000 workers with a loss of 1,225,000 man-days of production. In February, 1946, the big steel, electrical, auto, and other industrial plant strikes caused a production loss eighteen times that serious.

▸ Bureau of Labor Statistics figures showed also that the number of walkouts in progress—most of them minor ones—were off 37% for the quarter.

Strike Notices Filed

But BLS and other federal labor agencies had tempering notes in their announcements of the quarter's labor peace record: As March ended, strike notices were being filed with the U. S. Dept. of Labor at a rate of 20 each day, and there was a list of 1,740 strike notices on file with the department—15% more than at the same time last year.

▸ While it's true that the strike notice has become a union weapon to be used to spur lagging collective bargaining—hence is a routine matter now—it's also a fact that it can point to trouble ahead.

▸ As a result, many labor observers have been interpreting growing signs of labor discontent over bargaining processes with soberness, some pessimism.

Reasons for Upheaval

Two things contributed to the early April break in the armed truce in labor relations:

(1) Strikes by the independent National Federation of Telephone Workers and John L. Lewis' United Mine Workers (AFL) made pointless any further restraint by CIO industrial unions. The damage has been done; Congress had been spurred into action on labor legislation of a type which cooler-headed labor leaders had sought to avoid.

(2) Tightly reined bargaining—which stressed continued production—had failed to show any progress for most industrial unions. Rank-and-file dissatisfaction was being voiced openly. Top leaders were at the point where they either had to show results, or take a tougher attitude toward employers.

The latter of these was reflected in a significant series of developments. CIO's Farm Equipment Workers filed a strike notice against International Harvester, charging company responsibility for "complete collapse" of contract negotiations. The bellwether United Steelworkers of America, CIO President Philip Murray's own union, called its executive board and national wage committee into a meeting to discuss strike plans. The CIO's United Automobile, Aircraft & Agricultural Implements Workers and United Electrical, Radio & Machine Workers increased pressure on employers for a quick and favorable settlement of contract demands.

Steel Bargaining "Bitter"

In the steel industry, the union complained that more than two months of bargaining had resulted in no agreements whatever. While, on the surface, parties maintained a friendly attitude; beneath, both agreed that negotiating sessions have been the bitterest fought so far. Even such minor proposals as one for a strengthened rehiring rule for veterans resulted in protracted debate, and ultimate deadlock.

WAGE DEMANDS IN KEY INDUSTRIES

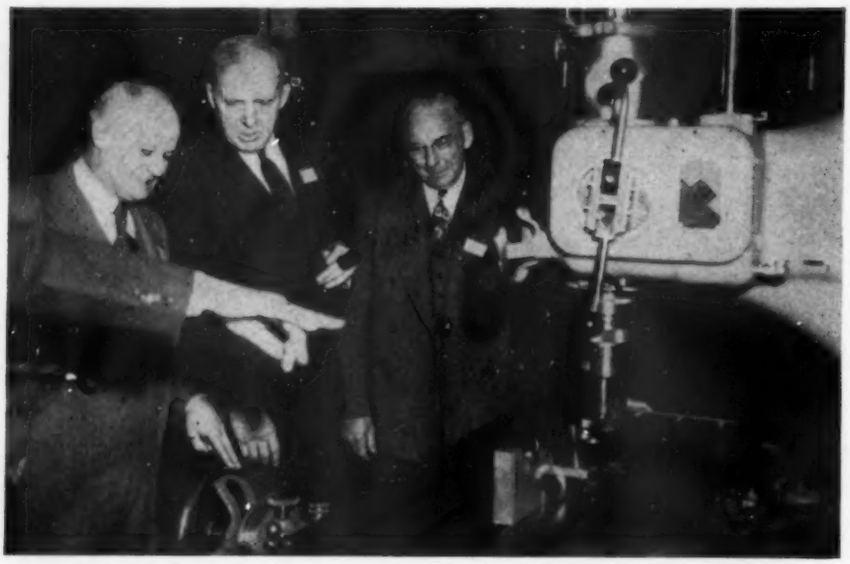
NEW YORK—Contract demands from unions in key industries give a clear indication now about what labor's 1947 wage demands really amount to. Final settlements will not be at demand figures, but what unions ask is an important starting place for bargaining. Major demands include:

Automotive .....23½¢ an hr.
Electrical Mfg.....25¢-30¢ an hr.
Steel .....Probably 18¢
Railroads .....20¢ an hr.
Nonferrous Metals 25%
White Collar.....$10-$15 a week (30%)

Many settlements already have been made on a "down payment" basis. Electrical agreements have averaged 10¢ an hour. Automobile manufacturers have been able to settle for 10¢ to 15¢ hourly raises, subject to upward revision.

Guaranteed annual wages, portal-pay clauses, and health and welfare fund provisions are major union demand. All are potentially costly for employers. It's probable, however, that they will be—in large measure—bargained away this year. Unions are laying groundwork for future campaigns, more than making a prime issue of these so-called "fringe" demands this year.

No such question exists on the matter of wages: The only doubt is about how much pay will increase this year.



New Sales Approach—Bryant Machinery & Engineering has new Chicago sales room where customers can see machine tools in actual operation. Here Henry B. Cleereman (right) and A. G. Bryant (left) are showing Tell Berna of National Machine Tool Builders Association (center) new Cleereman jig borers and upright drills at meeting attended by 100 distributors and their representatives

Detroit

TOOLING FOR '48 MODELS STILL POSSIBLE... HIGH COSTS MAY CHANGE THINKING ON ANNUAL MODELS... SHEET SHORTAGE ACUTE

Auto Payrolls Increase

Employment in the Detroit and Michigan plants seems to be on the upgrade, after the dip at the turn of the year. Freehand estimates are that Detroit factories have added some 20,000 workers since the start of January. Schedules are lengthening, too—in February the average work-week was 38.8 hours.

▸ Average weekly earnings in February, therefore climbed to $55.92 in Wayne County. The General Motors annual report, incidentally, shows the average indicated annual pay for hourly rate employees stood at $2,992 in the last 1946 quarter.

▸ From tool and die shops, whose employment totals seem to be temporarily stabilized at a level slightly in excess of the early part of this year, comes indication that today's average skilled man earns $1.96 per hour. The semi-skilled and maintenance average is $1.328. Both these rates are slightly higher than prevailed a year ago.

Automotive Tooling Signs

There are some growing signs that there may be a bit more automotive tooling for 1948 models than was heretofore expected. The reason lies in timing.

▸ When comparatively little tooling began to appear in February and March, the indicated conclusion was that changes would be much more modest than had been expected. Now it appears that some companies are thinking of introducing their 1948 models perhaps as late as December, rather than in August or September. This obviously juggles the makeready timetable: tool and die orders which would normally be placed in the early months of the year need not go into the shops before May or June. Some such are likely to turn up ahead.

▸ A few companies are having problems obtaining enough skilled help to get work ready for tooling release. One speaks of a sharp scarcity of modelers. Pattern-makers are being sought in almost daily advertisements.

Tooling Costs Cause Concern

What goes for parts, goes, of course, for tooling. Top officials of one of the largest companies described themselves as "horrified" by today's tooling costs, as compared with their prewar budgets. This particular concern feels its tooling bill has grown so large that annual model changes may no longer be justifiable.

▸ Boiler plate required for die bases is becoming very hard to get, and Detroit shops are scouring their steel sources for it. Particularly in demand are angle iron shapes. Some mills which formerly supplied such items before the war discontinued them during the war years, and this has considerably reduced the supply in this area.

Sheet Steel Demand Intense

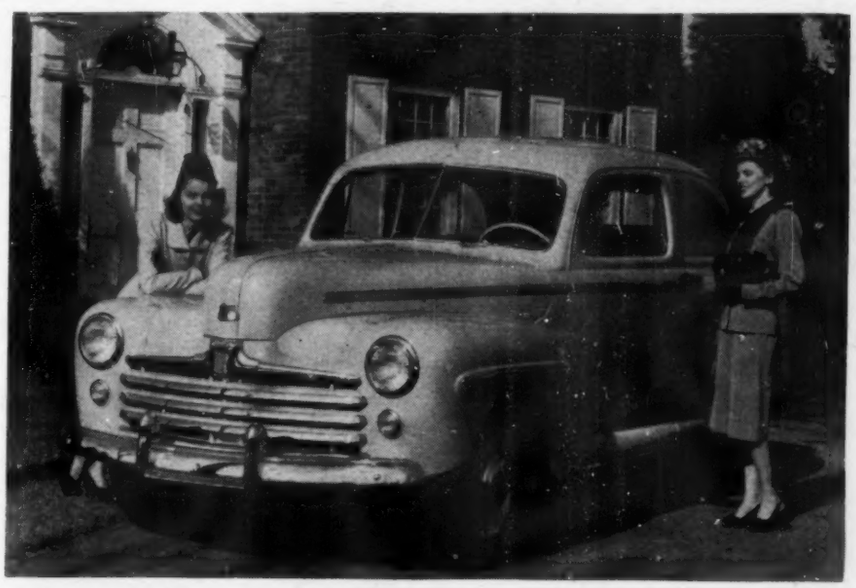
Sheet steel, of course, continues exceedingly scarce. One estimate is that the automobile companies would take 20% to 25% more sheet than they are now getting. The demand is so intense that there are instances on record where companies have substituted cold rolled for much more inexpensive hot rolled for various specifications when they found themselves able to obtain the former.

▸ Some orders are being booked for third quarter delivery, which means partly for 1948 model requirements. Insistence on those promises, even this far ahead, is as pressing as for current wants.

▸ Some stamping plants are finding sheets so hard to obtain that they have been driven to the expedience of sorting scrap piles of other companies, and buying odd sizes which can fit their small parts output. There seems to be quite a business of this sort going on. Reports tell that one Detroit company has made a business of gathering up odds and ends of usable scrap and selling them in bundles for stamping use, at high and fancy prices.

FATHER OF MASS PRODUCTION

Henry Ford's death early this month closed the career of a man whose industrial contributions to American progress will long stand as living memorials to his wisdom, initiative and achievement. He was the founder of modern American mass-production methods, and his Model T automobile was responsible for profound changes in the American way of life. He exercised the economic philosophy of continued cutting of the price of the product as improved methods of production made it possible. His fathering of belt conveyor system and assembly line changed production techniques and made him one of the world's richest men.



Spring Fords—Typical of the new Fords is this deluxe six-cylinder, three-passenger business coupe available in ten new colors. Among the numerous exterior and interior styling changes are the relocation of parking lights, heavier bumper guards, sturdier doors and lowered fender moldings

Rear-engined Tucker Car Expected To Hit Assembly Lines by July 1

CHICAGO—More than 1,200 lb. of aluminum will be used in the rear-engined Tucker Torpedo, which will have a curb weight of about 2,700 lb., according to Preston Tucker, president, Tucker Corporation, who discussed the new automobile at a meeting of the Chicago Production Conference. Engine cylinder castings, wheels and disk brakes all will be aluminum. Chassis and body will be steel. The company expects to have 25 to 30 hand-built models ready for display about June 1, and plans to start assembly lines the first week of July. Mr. Tucker said that present plans call for the assembly of 200 cars in July and 2,200 in August.

Design in Final Stage

It is expected that in final plans, now being reviewed for design simplification, the car's wheelbase will be 128 in. Independent suspension will be used for all four wheels, as will disk brakes having four times greater braking area than now used on conventional cars. Brakes are air-cooled and self-draining. No instrument panel will be used. In its place will be a 3-in. thick pad of sponge rubber. Speedometer will be mounted on the hood in place of the conventional radiator ornament, and the gasoline gage will be mounted near the door at the driver's left. No other instruments will be used. Instead, a flashing red light will indicate when engine conditions are not satisfactory.

Liquid-cooled Engine

The six-cylinder opposed engine fires on all six throws, has low pressure (600-psi.) solid fuel injection, uses poppet valves in cylinder heads, and has a 24-volt ultra high-frequency ignition system. Engine is liquid-cooled in a cooled system; will not operate if oil pressure drops to a danger point; and is expected to have a compression ratio of about 8-to-1. Cylinder bores will be sprayed with Ampco bronze before final precision boring. The engine is mounted on its side crosswise of the car, and drives to the rear wheels through separate torque converters, gear boxes and universal joints.

Rubber torsion springs will be used in all four wheel suspensions. Tires will be 13 x 7.00, a size Mr. Tucker expects to become popular in the near future.

Freight Car Shortage Plagues Chicago Metalworking Firms

CHICAGO—Although it is receiving less publicity lately, the shortage of freight cars is growing worse and is hampering the operations of many metalworking firms in the Chicago area.

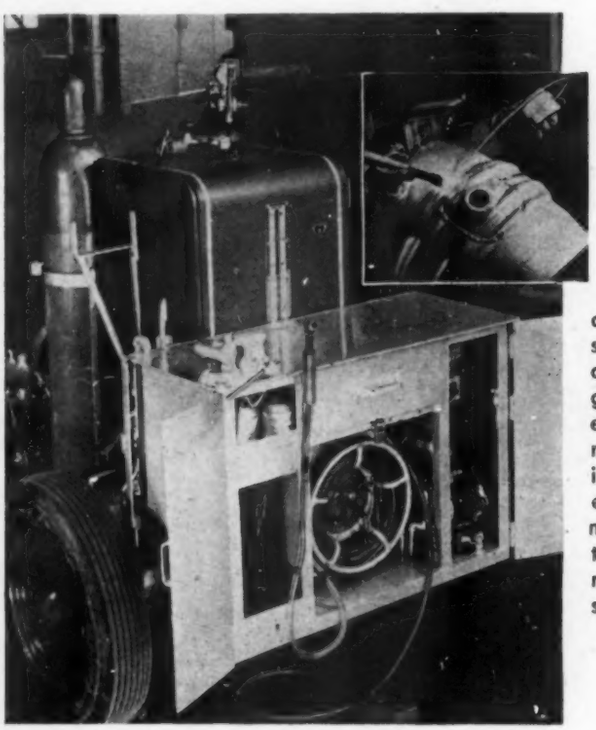
Car loadings in the first quarter of this year were the largest since 1930, but there are fewer freight cars in use than there were 17 years ago. Traffic experts of Chicago manufacturing firms say that their troubles with freight will get worse before they get better.

Meanwhile car builders are stepping up their output. Pullman-Standard's production rate of freight cars is double that of the 1946 average, and the Michigan City, Ind., plant is turning out 39 cars a day. The plant has a backlog of 9,100 freight cars. The plant will soon start on a run of 6,000 cars built to Pullman's new standard specifications.

Regional Industrial Development Bill Reintroduced by Sen. Flanders

WASHINGTON — The Commerce Dept. has found a Republican sponsor for its pet postwar program of helping out regional development of under-industrialized areas. The sponsor is freshman Sen. Ralph E. Flanders, Vermont machine tool manufacturer, a moving spirit in the Committee for Economic Development, and a long time member of the Commerce Department's Business Advisory Council.

Flanders has re-introduced last year's Democratic Bailey-Hayes bill authorizing a $5 million program of technical help and advice to local planning and development groups. Of the money, $3 million would go to Commerce and $1 million each to the Labor and Agriculture Depts.



Welding Without Fluxes—A metal arc welding unit, designed by Aluminum Co. of America's welding section engineers, for welding aluminum electrical conductors during construction and assembly operations, employs argon gas, inert to both electrodes and aluminum, to eliminate fluxing and cleaning operations. The unit is mounted on a road-type trailer for more easily moving it between the sites of plants under construction

10,000 Visitors View Exhibits At Engineering Progress Show

PHILADELPHIA — An Engineering Progress Show, believed to be the first of its kind, was held here April 5 to 13. Sponsored by The Engineers' Club of Philadelphia in cooperation with Franklin Institute, the 22 exhibits in Franklin Hall attracted an estimated 10,000 visitors.

Organized by the junior members of the club, the show was designed to highlight new engineering developments in industry. Greatest interest was shown in the pilot model EDVAC computing machine developed by the University of Pennsylvania for the Ordnance Department. The computer will add a column of 2,000,000 ten digit numbers in 64 sec.

Among other interesting displays was the model 9.5A aviation gas turbine built for the Navy by Westinghouse Electric Corp. Weighing 160 lb., the turbine develops a thrust of 275 lb. (equal to 275 hp. at 375 mph.) with a fuel consumption of 70 gal. per hr.

Washington

SURPLUS DOLLAR RETURN DROPS... ODT STUDIES STEEL NEEDS FOR FREIGHT CARS... TOKEN PRICE CUTS SOUGHT

WAA Demise Brews Battle

A typical Washington battle of bureaus is brewing over liquidation of War Assets Administration. Administrator Littlejohn wants to clean his shelves of war surplus by the end of 1948, and turn the residue over to an old-line government agency or department.

But some agencies, which declared surplus items, will regard themselves as claimants and want it back again—especially if by that time they've had a thorough economy treatment by Congress. WAA says it has sold $16 billion worth of goods, has $13 billion still to go. A year ago, the government registered a 45¢ return on the dollar; rate is down now to 37¢ and will go lower.

Imported Germans Opposed

Some American scientists are annoyed at an Army attempt to place a number of German scientists in university and industrial jobs here. The Army has already "picked" the Germans' brains, but wanted to keep them around for further reference. The Americans resent the job competition and some don't like working alongside former Nazis.

There's no quarrel with working Germans on rockets, at which their skill is superlative, but brows are raised at their employment on radar, a field in which the U. S. far outclassed Germany. Imported Germans are being kept off atomic projects.

Wallace Melody Lingers

Opposition has been raised to the way Henry Wallace split up the Bureau of Foreign and Domestic Commerce into five pieces: economics, domestic commerce, international trade, small business, and field services. Some Congress committeemen say it is uneconomical and may insist that "the business man's section of the Commerce Dep't." become a single unit again. Other major Commerce divisions, like Bureau of Standards, Patents, and Census, would be left as is. If the change is made it would wipe out the last traces of Wallace in the federal government.

Steel for Freight Cars

In an effort to boost freight car production to 10,000 per month, manufacturers called for 171,000 tons of steel monthly, or 17.1 tons per car. The steel industry committee, working with Office of Defense Transportation, said that was too much and offered 15.1 tons per car.

Meanwhile ODT is trying to determine actual tonnage required per car. Output of cars in March fell to 3,000 from estimated 3,400, but producers are hoping to make 5,000 this month. ODT tells AMERICAN MACHINIST the industry has been building 8,000 cars per month, including export to France, and believes it can reach the 10,000 mark by July.

Ship Committee Nears End

Disintegration of the Shipbuilding Stabilization Committee, established in 1942 to regulate shipbuilding wages, is in prospect. Its life was intended for the duration of the emergency declared by the late F.D.R. in 1939, which still exists.

Chairman E. A. McMillan has been unable to raise a quorum of six industry representatives to consider the 1946 wage review. Another effort was being made to convene the committee before, or shortly after, the Pacific Coast Zone meeting set for May 12.

When the committee meets, the question of dissolving the committee will take precedence over that of conducting wage review. CIO, AFL, and independent union representatives will push for dissolution.

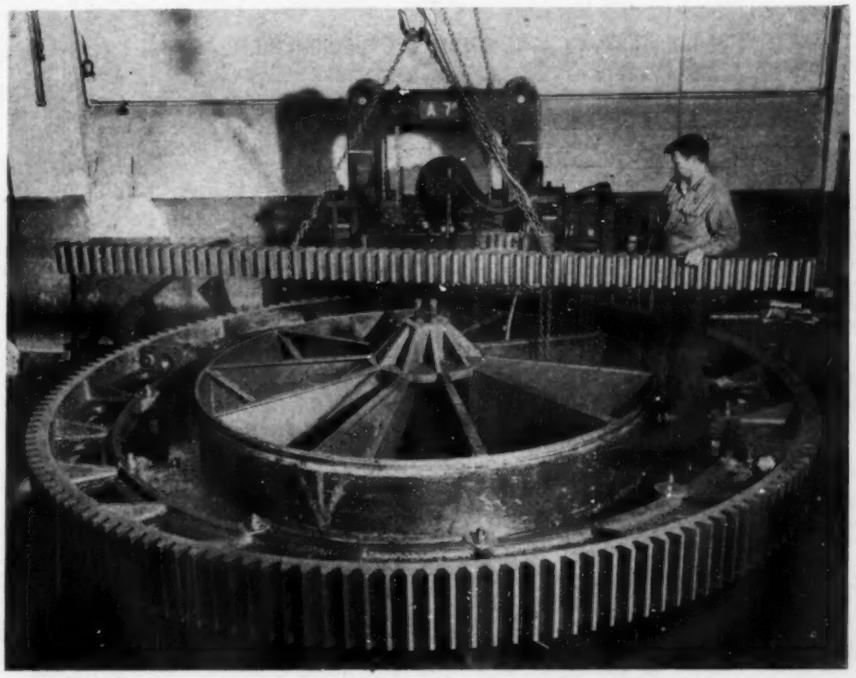
Administration's Price Crusade

Steel, chemicals and other basic commodities are being pushed hardest in the Administration's attempt to talk prices down. The President has twice hit at high prices from the high pulpit of his press conference. Particularly, he is after steel, key to the entire economy.

Industries that claim they can't cut are urged to announce they would like to, and make a few token reductions to show good faith. And finally, those who can't or won't cut are asked to pledge no increases this year—after the example of Worthington Pump and Gillette Razor. The campaign is not a mere general appeal; Administration bigwigs actually tackle individual industrialists they know best in an effort to gain cooperation in cutting prices.

Military Quiet Explained

Very little is heard on military projects because (1) old ones are now in the continuous state as the fiscal year nears its close, with new projects awaiting July; (2) agencies are so busy fighting budget cuts they haven't time to ballyhoo their works.



Largest West Coast Gear—180½ in. in diameter, this gear which is believed to be the largest one piece gear of its type ever made on the west coast, is shown being cut on machine specially designed and built by Western Gear Works, Engineers, Seattle. Spur gear is one of set of four, complete with pinions, for use on huge cement kilns. Gear has 160 teeth, 3½ in. circular pitch and 14 in. face

Engineers Inspect German Machines For Possible Production Advantages

FRANKFORD ARSENAL — Engineers and production men are studying the German machine tools and inspection equipment on display here until May 2 to see if there are ideas or methods which can be adapted for use in this country. The exhibit includes 15 machines and is sponsored jointly by the Office of Technical Services of the Dept. of Commerce, Ordnance Dept., NMTBA, and Army Ordnance Assn.

Most of the machines are now operating but they will not be given exhaustive tests until after the exhibit closes.

Some of the machines do not show marked difference from American design—this is especially true of such standard machines as cylindrical grinders and engine lathes. Most are of compact design and maintenance appears to be difficult.

Boring with Mirrors

A center of interest is the Lindner jig borer, Model M, Type NR 15, which has an optical system to provide setting to 0.001 mm. Two mirrored cylinders are etched with a screw thread of 2-mm. pitch. One is mounted in the table for longitudinal and one for transverse movement. Light beam reflected from cylinder is viewed by telescope.

In operation the mirrored cylinder is rotated until one of the threads is aligned with the cross hairs of the telescope. The cylinder is then rotated to show the desired amount of table travel. Rotation of the cylinder is measured directly in 0.01-mm. increments of thread position and by vernier to 0.001 mm. The table is then moved until the thread again is aligned with the cross hairs of the telescope and the desired travel has been obtained.

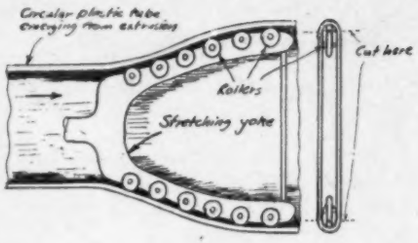
Another machine with an optical system is the Ultra projection form grinding machine, Model PFS. The image of the work and grinding wheel are thrown on a comparator screen during grinding. Two large handwheels to control grinding-wheel travel are mounted in front of the screen.

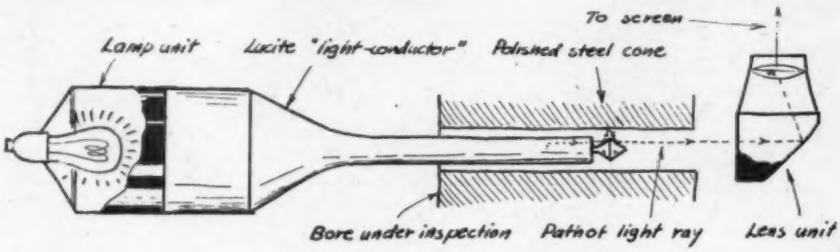
Two telescopes which focus individually give a choice of about 16 to 1 or 64 to 1 magnification. Limited to small work, the grinding head oscillates at a fixed rate of speed through a distance of about 1½ in.

Plastic Sheet Stretched

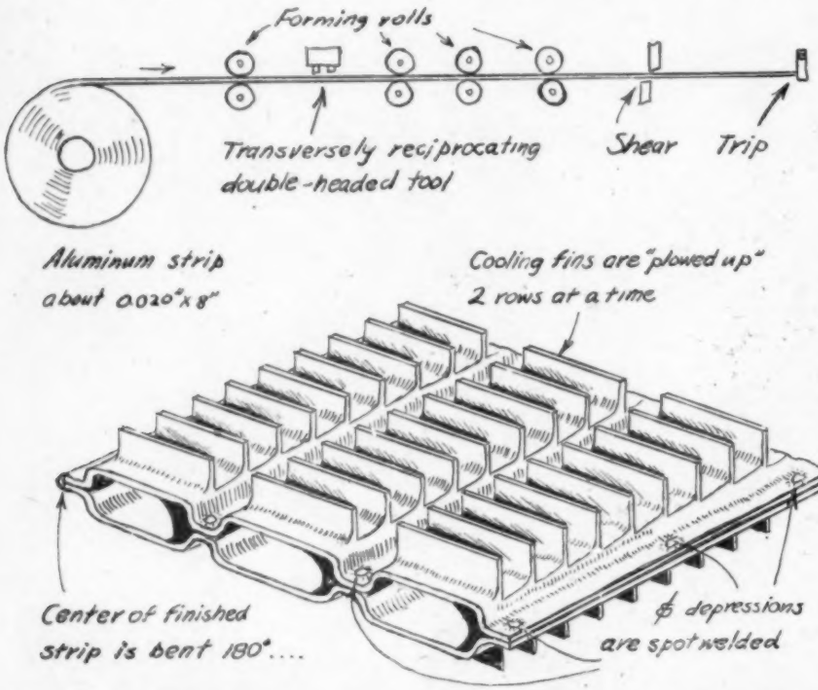
An unusual attachment for a plastic extrusion press is a yoke mounted in the end of the extrusion die over which the extruded plastic cylinder is stretched. A blast of air cools the plastic where it contacts the rollers in the yoke to prevent rupture. The remaining section is stretched about 35% as it is pulled over the yoke, producing thinner and wider strips. The section in contact with the rollers is trimmed off leaving two continuous strips which pass through tension rolls (to provide the force needed to pull the plastic over the yoke) and are wound on reels.

A device for visual inspection of bores in diesel injection pumps projects a reflected image of the surface on a screen. Light is transmitted through a lucite bar inserted in the cylinder to a polished steel cone from which it is reflected to the bore, to the other polished conical surface and from there through a lens to the screen. As the lucite bar is moved through the bore the entire interior surface can be studied.





Top: Plastic cylinder is drawn over yoke to produce thin strips. Bottom: Image of bore is projected on screen for visual inspection


Forming rolls
Transversely reciprocating double-headed tool
Shear
Trip
Aluminum strip about 0.020"x 8"
Cooling fins are "plowed up" 2 rows at a time
Center of finished strip is bent 180°....
depressions are spot welded

Finned aluminum radiator tubes are made from coiled strip. First pair of forming rolls slightly forms nine grooves. Reciprocating head with two single-point tools cuts and turns up two rows of fins on each stroke. Strip advances during return stroke of head. Three sets of forming rolls finish grooves and trip actuates power shear which cuts off desired length. Strip is formed with eight banks of fins, folded at the center and presumably seam welded at the joint. Sketch at bottom shows radiator section made from six banks of fins

Southern California Industrialists Optimistic Over Production Outlook

LOS ANGELES — Industrialists in southern California are looking forward with more optimism today than at any time in recent years. Most business leaders still anticipate a recession, signs of which may already be apparent but not recognized, but practically all forecast many years of continuing prosperity following a slight leveling-off period.

Among developments which later may be recognized as more significant than now considered was the lay-off, during the latter part of March, of about 400 employees at the Los Angeles Studebaker assembly plant due to a shortage of parts and equipment. The paradox of an automobile assembly plant, flooded with orders, closing down for lack of parts and other equipment while other plants—the Lincoln-Mercury plant at Maywood, the Chevrolet plant at Van Nuys—were straining to get their lines rolling had a sobering effect.

Additional Work Sought

Also significant is the fact that during March local firms advertised for additional work of the following natures: automatic screw machining; wire and sheet metal fabrication; turret and engine lathing; enameling; steel forming; butt and flash welding, and some types of work on plastics.

While admitting that the much-discussed set-back may possibly occur, business leaders here continue to predict that southern California's well-balanced economy will enable it to weather a recession much better than other areas. Although this area's economic structure is less diversified than formerly, a good balance has been maintained between the durable goods industries, which employ 60% of the industrial production workers, and the non-durable goods industries, employing 40%.

Double Prewar Employment

Factory employment here has fallen from its wartime high of 457,000, representing 51% of California's production workers, to about 250,000, a figure still double such employment in prewar years and representing 53% of the state's production workers.

Wages paid to production workers in Los Angeles county rose from 71¢ an hour average in 1939 to a wartime peak of $1.24 in December, 1944, and to $1.36 an hour in January, 1947. The last figure is 90% higher than the prewar average and 10% higher than the wartime peak. Average weekly earnings now are $53.30 for a 39.2-hour week, against $27.62 for a 1939 38.7-hour week and $57.55 for a 46.2-hour week at the war-time peak.

Industrial Progress Noted

Looking forward to a continuing industrial growth in southern California, business leaders point out that this area now has passed the following areas, which formerly exceeded it in the number of production workers on factory payrolls: Providence-Fall River-New Bedford; Cleveland; Bridgeport-New Haven-Waterbury, and St. Louis. Industrialists here claim a tie with Pittsburgh for sixth place in the list of industrial centers, with New York, Chicago, Detroit, Philadelphia and Boston heading the list.

In February, 21 new factories and the expansion of 30 existing ones were announced, representing an investment of $5,298,500. The new plants will provide employment for 525, while the expansions, which account for $4,270,500 of the total, will make jobs for 1,243 others. To the end of February, this year's total is $11,861,500, to be spent for 97 new or expanded factories which will provide 4,543 new jobs. The cost of the 38 new factories announced this year amounts to $3,465,000.

Payroll Index in Chicago Reported At Highest Level in 18 Months

CHICAGO—In Chicago, the latest report of the Association of Commerce and Industry shows that business is continuing at high levels. The index of employment is at the highest point in 18 months, and the payroll index is at the highest point in two years. Contracts for construction of new manufacturing facilities are also climbing in number and in dollar value.

The increase in Chicago manufacturing activity compared with prewar is most marked in the rise in payrolls. Taking the average from 1935 to 1939 as 100, at present the payroll index is 286.

Local Union Loses Bargaining Rights In Demanding Basic Steel Wage Rate

WASHINGTON — Insistence by a local union of the United Steelworkers, CIO, that it receive the same 18½¢ wage increase granted by U. S. Steel Corp. last year has cost it bargaining rights at the small United Welding Co. plant at Middletown, O.

Backed by a recent National Labor Relations Board decision, the company, engaged in the manufacture and welding of machine parts, has signed a contract with the United Welding Independent Union as the exclusive bargaining agent of some 150 production workers. The company granted a 9¢ hourly raise when the contract was signed, in addition to 5¢ when the work-week was cut to 40 hrs.

CIO Out in Cold

These same workers got a 10¢ increase a year ago when they returned to work in defiance of the CIO mandate to hold out for the 18½¢ pattern increase.

As things now stand, the CIO is out in the cold. It has asked NLRB for a rehearing of the dismissal of the CIO union's charges of unfair labor practices against United Welding. The way it has been acting, NLRB can be expected to stick to its finding that the company did not undercut the striking CIO union when a majority of the employees accepted the 10¢ offer and returned to work. The company had written to all strikers advising them of its inability to meet the industry-wide demand.

A provision of the Taft Bill considered by the Senate Labor Committee would make it an unfair labor practice for an international union to insist that its local unions hold out for a particular wage settlement. If enacted, this would prevent the CIO Steel Workers from repeating last year's performance, in which the policy committee insisted that all employers, including the smallest steel fabricator, had to meet the 18½¢ wage increase paid by the basic steel industry or suffer a strike.

Taft Interprets Issue

Sen. Robert A. Taft of Ohio, Labor Committee chairman, said he understood that members of six locals of the United Steelworkers withdrew from the International Union in Ohio over last year's wage issue, and that they were without bargaining rights.

Taft's proposal would call for NLRB certification of local unions, rather than internationals, with the international officers retaining the right only to guide and advise the locals. National officials however, could not prevent local unions from accepting any contract terms they wished.

Aircraft Developments Continue On Lean Technical Research Diet

Unless Congress comes through with money for military airplanes, the aircraft industry will live on a lean research diet for a long time.

Helicopters are making sound, unspectacular progress for special uses and for short run services; simplification and efficiency are steadily improving.

For years light plane makers have shunned technical development aid from Civil Aeronautics Administration, fearing government participation in the industry. Now manufacturers are in money pinch and are ready to accept CAA help in improving plane utility, but they may be too late—Congress is putting economy squeeze on CAA. However, in an effort to cut costs, Aircraft Industries Association is starting a light plane parts standardization program. First on the list are batteries, wheels, brakes, axles and standard engine crank shafts which could take several propeller makes, instead of the usual one.

Noise Abatement Sought

Multi-bladed, smaller diameter propellers, having less tip speed and making less noise, are being developed by manufacturers and by National Advisory Committee for Aeronautics. The long delayed improvement is now being pushed to meet growing community nuisance charges against private flying.

Both Wright Aeronautical and Pratt & Whitney are setting up long-term turbojet development programs, in an effort to capture jet leadership, now held by General Electric and Westinghouse, for the aircraft industry.

Seek to Overcome Icing

Strong tendency to icing in axial flow turbojets may be overcome by inertia separation (sharp bend in air intake which frozen globules cannot follow) and by introduction of warm air just before intake air reaches the compressor.

Increasingly important as aircraft speeds exceed 400 mph. is the smoothness of skin contour for laminar flow. The British begin at the rolling mill with a surface tolerance of 0.003 in. per 3 in. of flatness, put the skin in the jig and build to it, resulting in a contour over entire 90 ft. span which is smooth within 0.002 in. in 2 in. for 55% of the chord from the leading edge.

Surplus Inventory Figure Revises Attitude of Cleveland Dealers

CLEVELAND—A much more optimistic feeling prevailed among machine tool builders, dealers, and the ranks of the members of the National Machine Tool Builders Association in Cleveland when WAA inventory figures as of Feb. 28 for surplus machine tools showed just about half the number in surplus than the industry had been led to believe.

According to a report released this month, machine tools with an original cost of $567,098,000 were in surplus as of Feb. 28, as opposed to a billion dollars as expressed by some representatives. Tell Berna, General Manager of the Machine Tool Builders Association, says this still does not give the true picture, since a large portion of these tools, numbering about 190,000, are specials and cannot, even under extreme conditions, find their way back for ordinary use in industry.

With about 8,000 machine tools tagged to be placed in reserve for a possible national emergency, the program which called for more than 100,000 tools to be placed in reserve is far behind its quota. The more optimistic of those within the machine tool industry see a chance for thousands of those tools now in surplus to disappear quickly from the market and find their way into such a reserve.

Restricted Hot-metal Supplies Cause Scrap Market to Fluctuate

PITTSBURGH — Scrap which had been softening as a result of company inactivity in the market is once again in a state of flux due to restricted hot-metal supplies. If the amount of scrap in the melt is increased at the open hearths, the improved position in respect to scrap could be dissipated.

Steel interests here believe the increase in the available supply of sheets will be so small as to continue tight conditions for several more months.

New Plate Business Poor

Plate and shape mills are going to be heavily obligated for freight car equipment and this will tighten an already tight situation over the near term. New plate business is poor because there is no chance to schedule it soon. Much the same applies to shapes.

150 U. S. Firms to Exhibit At Paris Trade Fair, May 10-26

PARIS—The United States will be represented at this year's Paris Trade Fair, to be held May 10-26, by more than 150 firms. Many American machine tool companies are expected to have exhibits. Some 15 European countries have lined up for representation at this year's Foire de Paris. Ten countries have their own separate national stands—Austria, Belgium, Czechoslovakia, Denmark, Finland, Italy, Poland, Sweden, Switzerland and Yugoslavia. To meet the advance requests of exhibitors, the fair ground at the Porte de Versailles has been increased to 125 acres.

Navy Transport Helicopter—The Navy's XHRP-1 or "Rescuer" is the first successful tandem rotor helicopter. Built at Piasecki Helicopter Plant, Sharon Hill, Pa., the machine is powered by a 600 hp. Pratt & Whitney engine, and will cruise at over 100 mph. with a load of over one ton. 400 cu. ft. of space is available for cargo or passengers. Powerful lift forces at each end of the fuselage eliminate serious balance problems

Names in the News

Wendell E. Whipp

J. A. Raterman

Wendell E. Whipp, president of Monarch Machine Tool Co. since 1931, has been elected chairman of the board, succeeding the late **F. P. Thedieck. Jerome A. Raterman**, formerly executive vice president has been named president. Mr. Whipp joined Monarch in 1912 as general manager. In the ensuing years he built the company from a handful of employees to its present eminent position. He has served the industry over many years, including a term as president of the National Machine Tool Builders Association. Mr. Raterman came to Monarch in 1917 as a lathe operator. During the next 20 years he progressed through almost every job in the shop. and office. In 1937 he was elected a vice president and in 1943, treasurer. A year later he became executive vice president and treasurer.

E. Halsey Brister has been appointed sales manager of Bay State Abrasive Products Co., Westboro, Mass., to succeed the late **Arthur G. Green.** Mr. Brister has been with Bay State since 1944 as quality control manager and was associated with Norton Co., Worcester, Mass., for 13 years.

Frederick W. McIntyre, Jr., vice president, and **Charles H. Carswell,** treasurer of the Universal Winding Machine Co., Providence, R. I., have been elected directors of the Reed-Prentice Corp., Worcester, Mass.

Morse Twist Drill Co. has increased the size of its board of directors and added three new members: **Lloyd H. Stanton,** treasurer; **Morton J. Rainey,** general sales manager who has been associated with Morse since 1920; and **Anthony J. Snyder,** works manager, who joined Morse in 1913.

Harvey D. Miller has been elected president of the McKay Machine Co., Youngstown, Ohio, succeeding **Ambrose J. Wardle,** president of the firm for 25 years who has now become chairman of the board.

James J. Russell has been elected president of Revere Copper and Brass, Inc., to succeed **C. Donald Dallas,** who is now chairman of the board. Mr. Russell was formerly treasurer, secretary, vice president and director of the firm.

Harry Toulmin, Jr., president and board chairman of Hydraulic Press Manufacturing Co. and Industrial Metal Protectives, Inc., has been elected chairman of the board of the Tucker Corp.

Dr. Glenn T. Seaborg, co-discoverer of plutonium, has been named consultant in nucleonics to the General Electric Research Laboratory, Schenectady, N. Y.

Waldemar Naujoks has been elected president of the Bison Forge Co., Inc., Buffalo, N. Y. He was formerly chief engineer of The Steel Improvement & Forge Co., Cleveland.

C. W. Dalzell

Albert E. Zeisel

C. W. Dalzell has been named chief engineer of the Franklin Transformer Manufacturing Co., Minneapolis, Minn., succeeding the late **R. L. Anderson.**

Albert E. Zeisel has been appointed vice president in charge of sales of the Eutectic Welding Alloys Corp., New York City.

Elmer Schneider has been elected to the newly created position of vice president and director of engineering of Wheelco Instrument Co., Chicago. **Joseph A. Reinhardt** has been named plant manager of the firm.

Edwin E. Potter has been elected vice president in charge of the commercial aspects of General Electric Co's. relations with customers, with headquarters in New York City. Also, **William H. Milton, Jr.,** formerly assistant general manager of the Chemical Dept., has been elected a commercial vice president.

W. J. Eberlein

William J. Eberlein, general sales manager, has been elected a vice president in charge of sales of the Greenfield Tap & Die Corp., Greenfield, Mass. Mr. Eberlein has been associated with the firm for over 30 years having served as field manager, assistant to the sales manager and finally sales manager since 1943.

James Gerity, Jr., chairman of the board of the Gerity-Michigan Die Casting Co., has become president and general manager of the company. He succeeds **Louis W. Blauman,** who has resigned as president and director. **E. Martin Tallberg** resigned at the same time as vice president and director, while **Charles R. Shanks,** formerly vice president in charge of the Adrian division, has become executive vice president and assistant general manager. **William N. Schnell** has resigned as director, but will continue as vice president.

W. E. Curran has been named general manager of Rheem Manufacturing Co., San Francisco. He is also a vice president and director and will continue to make his headquarters in New York.

H. M. Hammond, former general sales manager, and **P. S. Dickey,** former chief engineer, have been promoted to vice presidents of the Bailey Meter Co., Cleveland.

Herman L. Moekle, vice president in charge of finance of the Ford Motor Co., recently retired. He joined Ford in 1913 and formerly served in various positions including those of secretary, assistant treasurer and director.

Robert C. Enos, a director of the E. W. Bliss Co., Detroit, has been elected chairman of the board to succeed **D. S. Harder,** resigned.

George D. Behlan has been named production manager and chief engineer of the Bradford Machine Tool Co., Cincinnati.

E. N. Goddard, founder of Goddard & Goddard Co., Detroit, has retired as president of the company, but will continue as chairman of the board. He has been succeeded as president by **E. A. Goddard,** former vice president and general manager, and **L. H. Goddard** has been elected a vice president.

George J. Read has been named general manager of Chelsea Products, Inc., Irvington, N. J.

BUSINESS ITEMS

Sheffield Corp., Dayton, Ohio, has purchased the **Murchey Machine & Tool Co.,** Detroit. The Detroit firm has been in business over 40 years and active management of the business will now be under the direction of Sheffield executives, **O. A. Ahlers,** sales manager and director, and **Albert F. Polk,** vice president and director. Operations will continue in Detroit for the present.

The O.K. Tool Co., Inc., Shelton, Conn., has organized a Chicago district office under the supervision of **David Bristol,** former chief tool designer of the firm. **Eugene Scovil** will be sales representative for southern Chicago and northern Ind., while **Frank Gaynor,** will be in charge of Iowa and southern Ill. Additional distributors for the firm are **Rickert Industrial Supply** in Milwaukee and **Martin & Prestegaard Co.,** Minneapolis.

Progressive Engineering Service has been made a division of the **Superior Tool & Die Co.,** Detroit, and moved its office to 6633 Rohns Ave., Detroit. **M. Golde** has been appointed general manager of the division.

Detroit Tube & Steel Co. has been formed by a merger of **Detroit Seamless Steel Tubes Co.** and **Bopp Steel Corp.** The new firm is a wholly-owned subsidiary of **Sharon Steel Corp.**

Eastern Industries, Inc., New Haven, Conn., has purchased the building, machinery and product production rights of the **McIntyre Co.,** Newton, Mass., which will be operated as a division of Eastern.

Independent Pneumatic Tool Co., Chicago, has opened a technical office in Sao Paulo, Brazil. **Reuben P. Rudy,** Thor Brazilian representative for the past two years, has been appointed manager of the new office.

Wiley's Carbide Tool Co., Detroit, has moved its Chicago office to 565 W. Washington Blvd with **J. Frank Ward, Jr.,** in charge.

The Dampney Co. of America, Boston, has appointed **Combustion Equipment & Insulation Co.,** 1900 Euclid Ave., Cleveland, as its agent in the Cleveland area.

The Baxter Co. has been formed in Cincinnati by **J. E. Baxter,** vice president of Burton-Rodgers, Inc., to utilize new developments in casting and forming plastic parts.

Federal Products Corp., Providence, R. I., has completed the addition of a modern three-story extension and a third floor to its main plant and installed machinery from its other two plants in the main one, bringing entire organization under one roof.

OBITUARIES

Harry C. Beaver

Harry C. Beaver, 70, vice chairman of the board of directors and former president of the Worthington Pump & Machinery Co., Harrison, N. J., died April 2. Before joining Worthington in 1931, he was associated with Westinghouse Electric & Manufacturing Co., Allis-Chalmer Mfg. Co., and Rolls-Royce of America, Inc. He joined Worthington as vice president in charge of sales, a director and member of the board and executive committee and soon became president.

E. L. Berry, 52, vice president in charge of production of Link-Belt Co., Chicago, died suddenly April 3. Mr. Berry joined the firm in 1914 and worked up through the ranks to hold such positions as works engineer, general superintendent and assistant general manager before being named vice president and general manager of the wartime subsidiary Link-Belt Ordnance Co. He was also a vice president and director of Link-Belt Speeder Corp.

S. Frederick Kemper, 79, president of the Cincinnati Die Casting Co., Cincinnati, died March 24. He was former president of American Pumps, Inc., Cincinnati, and founded the die casting firm in 1936.

Percy E. Glenn, 59, senior process engineer at the Harrison Radiator Div., General Motors Corp., Lockport, N. Y., passed away March 28.

Alfred E. Handler, 64, chief forging engineer of the Aluminum Co. of America, passed away April 1.

Raymond B. Zerfey, 59, chief engineer of the Tool Steel Gear & Pinion Co., Elmwood, Ohio, since 1917, died March 31.

Philip G. Franklin, 53, owner and president of the Young & Franklin Tool Works, Liverpool, N. Y., passed away April 1.

Charles S. Beach passed away in Bennington, Vt., in his 88th year. He was a contributor to AMERICAN MACHINIST in its early days and was a member of the American Society of Mechanical Engineers for over 50 years. A skilled mechanic, he operated his own shop for many years.

Joseph Keller, 73, co-founder and owner of the Keller Machine Co., Buffalo, N. Y., passed away April 1.

Robert S. Flanagan, 50, president of Flanagan Industries, Inc., Skaneateles, N. Y., died March 23.

Robert C. Weikum, 60, who operated a machine shop in Buffalo, N. Y., for nearly 30 years until his retirement, passed away March 25.

John P. Moynihan, retired general manager of the Blackstone Manufacturing Co., Jamestown, N. Y., died March 23.

MEETINGS

American Gear Manufacturers Association. 31st annual meeting. The Homestead, Hot Springs, Va. June 2-4. Newbold C. Goin, executive secretary, Empire Bldg., Pittsburgh 22, Pa.

American Iron & Steel Institute. General meeting. Hotel Pierre, May 21. Waldorf-Astoria Hotel, May 22. New York, N. Y. George S. Rose, Secretary, 350 Fifth Ave., New York, N. Y.

American Management Associa- 14-15. General management meeting. Hotel Pennsylvania, New York, N. Y. June 11-12. Edward K. Moss, director of Public Relations, 330 W. 42 St., New York 18, N. Y.

American Society for Quality Control. Annual convention and Midwest Quality Control Conference. Hotel Sherman, Chicago, Ill. June 5-6. Edward D. Thompson, general chairman, P. O. Box 1097, Chicago 90, Ill.

Metal Powder Association. Annual spring meeting. Waldorf-Astoria Hotel. New York, N. Y. May 27. Association Headquarters, 420 Lexington Ave., New York, N. Y.

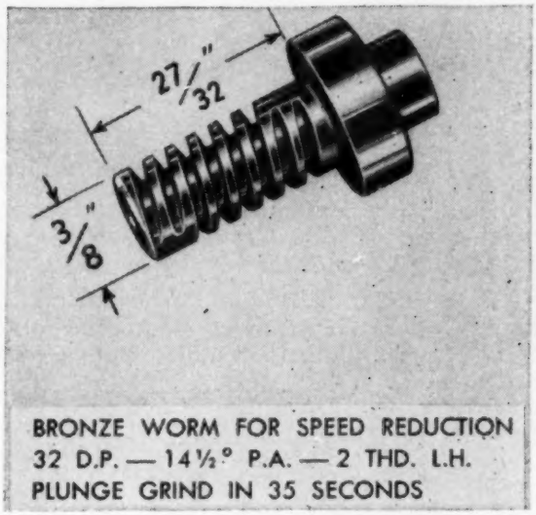
Society of Automotive Engineers. Summer meeting. French Lick Springs Hotel, French Lick, Ind. June 1-6. John A. C. Warner, general manager, 29 W. 39 St., New York, N. Y.

Society of the Plastics Industry, Inc., National Plastics Exposition. The Coliseum. Chicago, Ill. May 6-10. Wesley S. Thurston, director of public relations, 330 W. 42 St., New New York, N. Y.

SHEFFIELD MACHINE TOOL DATA

TFG #121

CRUSH GRINDING MULTIPLE START WORMS ON SHEFFIELD PRECISION THREAD AND FORM GRINDER



BRONZE WORM FOR SPEED REDUCTION
32 D.P. — 14½° P.A. — 2 THD. L.H.
PLUNGE GRIND IN 35 SECONDS

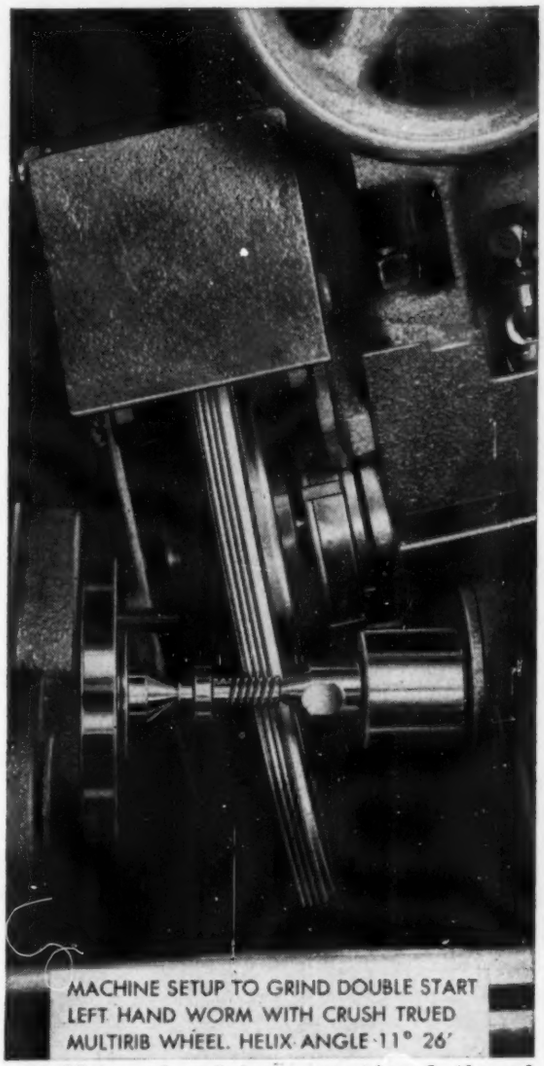
Multiple or single start worms can be quickly and economically produced by Crush Grinding with a Multi-Rib wheel.

Evidence substantiating this statement is incorporated in the following case history.

The part illustrated is a double start 32 diametral pitch worm with conventional 14½° pressure angle. Material is bronze. P.D. tolerance is to be held to .003 over wires. As practically all worms have clearance between the root and the mating worm wheel, a radius at the root presents no problem in assembly.

The multi-rib wheel, crush trued, was set at the required helix angle, 11° 26'. The wheel was briskly plunged to depth inside the outer center of the part so as not to cut through the thrust face. The cut was stopped close to the shoulder of the gear diameter to prevent the wheel marking the shoulder.

The grinding time of 35 seconds produced both starts simultaneously. Burrs



MACHINE SETUP TO GRIND DOUBLE START LEFT HAND WORM WITH CRUSH TRUED MULTIRIB WHEEL. HELIX ANGLE 11° 26'

usually produced in conventional thread milling are eliminated by crush grinding.

In the majority of cases, crush plunge grinding of threads or forms will reduce substantially your present manufacturing costs. Write for Bulletins M-100-145 and M-120-144.

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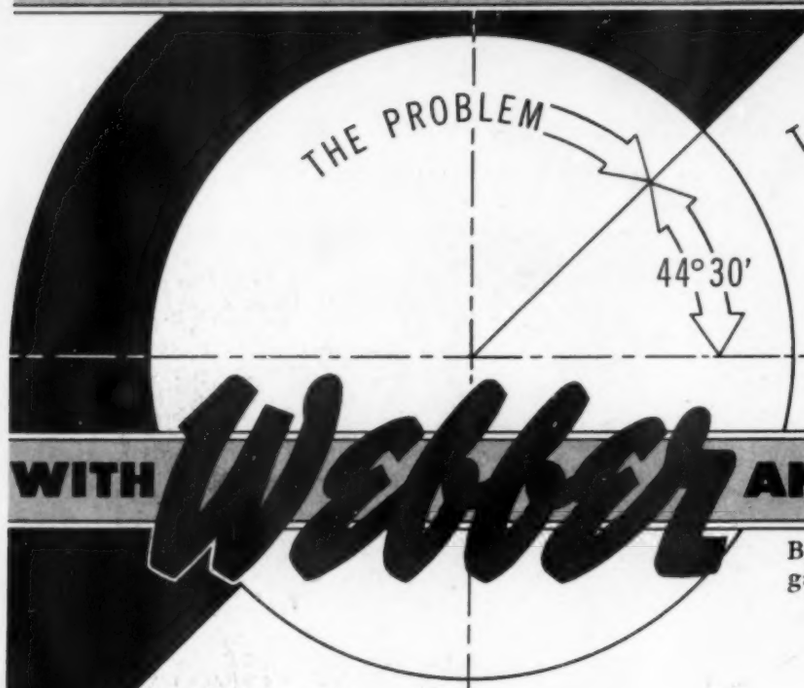
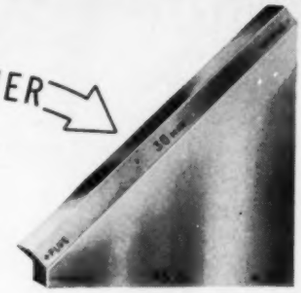
A COMPLEX PROBLEM IS MADE SIMPLE



THE ANSWER



WITH Webber ANGLE GAGE BLOCKS

By the old Sine bar method the following gage blocks and a Sine bar are required.

Gage Blocks . . .	.1005
	.104
	.300
	3.0
	3.5045
Sine for 44° 30' —	.7009093
	x 5
Multiplied by 5 —	3.5045465
Gage Blocks —	3.5045000
Residual Error —	.0000465

This error is approximately ½ of one-tenth in Sine bar set up which cannot be eliminated.

With Webber Angle Gage Blocks, you merely take a 45° angle block from your set wring on a 30' block with minus end of the 45° block contacting the plus end of the 30' block, and you have an angle of 44°-30'. Simple, isn't it? And what's more important, it is absolutely accurate. The proof being contained in the blocks themselves.

Detailed information available in bulletin which describes fully how blocks are used for making angular measurements. Write for your copy today!

Set No. 16-A provides a range of 370,800 angles in steps of 1 second. The No. 11-A set provides 6180 angles in steps of 1 minute. The No. 6-A provides 103 angles in steps of 1 degree. Prices range from $450.00 for the No. 16-A to $235.00 for the No. 6-A.

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CLEVELAND 11, OHIO

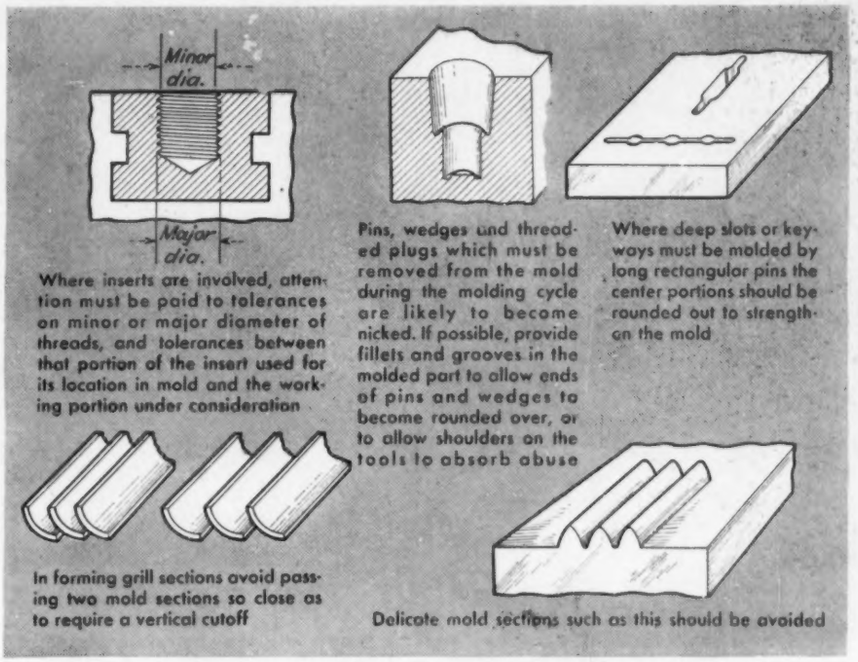
WEBBER MAKES PRECISION GAGE BLOCKS EXCLUSIVELY

- ★ Gage Block Sets in Steps of .00005".
- ★ Individual Special Size Blocks.
- ★ Heavy Duty Gage Blocks.
- ★ Angle Gage Blocks in Steps of one second.
- ★ Carblox (Carbide) Wear Gages.

Webber
PRECISION
GAGE BLOCKS

Pointers for Plastic-Mold Makers—III

COURTESY, PLASTICS DIVISION, GENERAL ELECTRIC COMPANY


Minor dia.
Major dia.
Where inserts are involved, attention must be paid to tolerances on minor or major diameter of threads, and tolerances between that portion of the insert used for its location in mold and the working portion under consideration
Pins, wedges and threaded plugs which must be removed from the mold during the molding cycle are likely to become nicked. If possible, provide fillets and grooves in the molded part to allow ends of pins and wedges to become rounded over, or to allow shoulders on the tools to absorb abuse
Where deep slots or keyways must be molded by long rectangular pins the center portions should be rounded out to strengthen the mold
In forming grill sections avoid passing two mold sections so close as to require a vertical cutoff
Delicate mold sections such as this should be avoided

Tolerances

1. Multiple-cavity molds generally require increased tolerances.

2. A good working tolerance for warpage from the average plane through the warped surface is ± 0.003 in. per in.

3. Practical tolerances for dimensions measured parallel to the mold parting line are ± 0.005 in., per in. at right angles to parting line, plus 0.015 in. and minus 0.000 in.

4. More leeway in "build-up" dimensions (parallel with molds pressure) should be allowed for coarse plastic compounds (a minimum of plus 0.015 in. and minus 0.000 in., increasing with the size of the part).

5. Variation in molded part dimensions may be caused by toolroom tolerances, distortion in hardening, mold wear or changes in molding conditions.

6. Tolerances should be specified only on important dimensions.

7. Warping can often be controlled by using cooling forms.

8. Close dimensional accuracy may often be more economically obtained by grinding or machining the finished part.

9. Cold-molded parts require tolerances approximately twice those for hot-molded plastics.

Molded Design

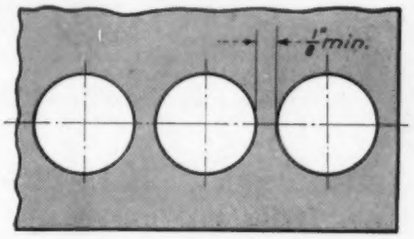
Sharp corners, unless produced in a mold built up of sections or unless located at the cut-off, call for more expensive mold work. Deep barriers and fins make mold work even more difficult.

Wall Thickness

1. Uniform thin sections speed the molding cycle and cut material cost.

2. When both thick and thin sections are called for in a molded part, thick sections should be designed with cores or holes so as to permit uniform curing.

3. Proper taper (2° to 3°) on vertical walls makes removal from the mold easier.



Minimum thickness between insert and wall should be 1/16 in., and 1/8 in. between any two holes

4. Accepted minimium wall thickness of compression molded parts is 1/16 in., although urea plastics with a wall thickness of 0.035 in. have been used as light reflectors.

5. In injection molding, thin-walled sections chill quickly and neutralize injection pressure. Sections of less than 0.050 in. should be avoided unless material path is short and high pressures are available.

Shrinkage

Shrinkage is affected by three factors: molding resins and fillers; product design and uniformity of sections and inserts; and aging and service (exposure to liquids and excessive temperatures).

1. Shrinkage varies with different types of resins and fillers. Immediate shrinkage can usually be estimated within 0.002 in./in.

2. Uniform cross-sections prevent varying rates of shrinkage and result in fewer strains in the molded part, reducing warpage and providing greater strength. Supporting ribs minimize shrinkage on large plane sections.

3. High temperatures and prolonged exposure to moisture increase shrinkage.

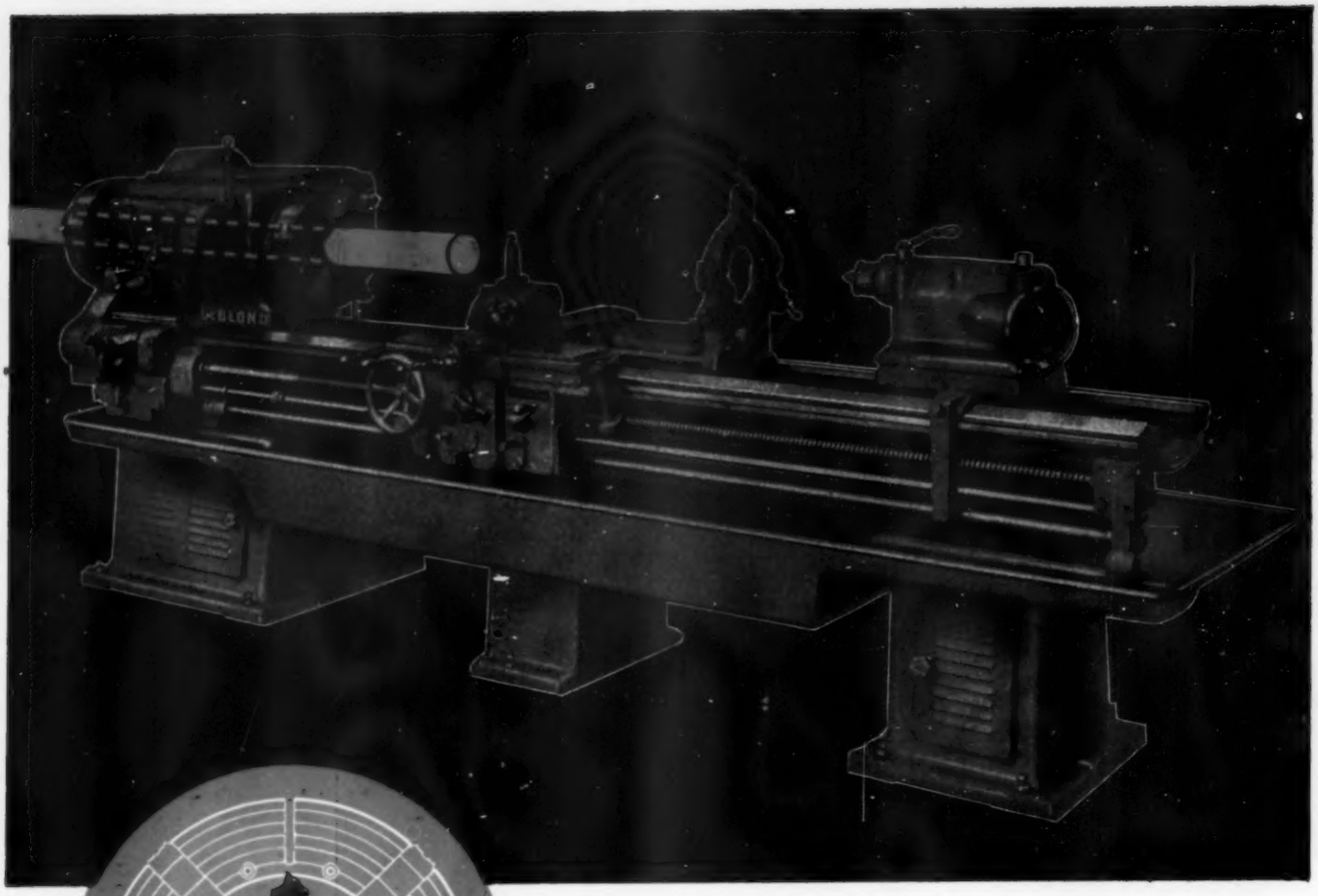
4. Design of part, size, shape and location of inserts, strength, elasticity and stability of compound determine whether a part will crack on shrinking.

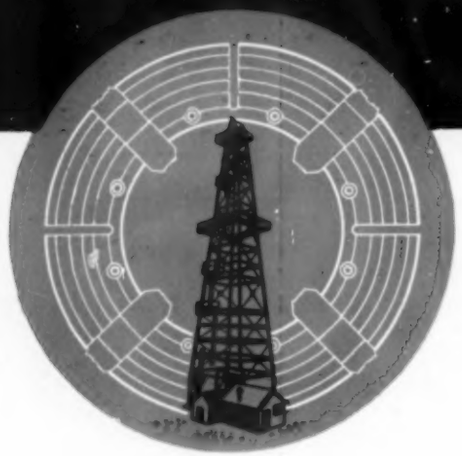
5. Molded parts are usually 0.000-0.020 in. shorter than the mold per linear inch.

6. Warpage may occur upon removal of the part from the mold. Cooling fixtures and cooling forms and sometimes the use of mold release agents help prevent this warpage.

7. Shrinkage performs a useful function by firmly anchoring inserts in the plastic. However, inserts so anchored will not stand as much stress as inserts that are molded into the compound.

8. Inserts with low coefficient of





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...A 5¼" HOLE TO BE EXACT

OIL COUNTRY LATHE FEATURES

- Quiet, powerful headstock with 12 geared speed changes.
- Automatic lubrication system in headstock.
- Flame hardened steel bed ways, front and rear.
- One-piece apron with positive jaw feed clutch. One-shot lubrication.
- Apron controlled reverse to spindle thru powerful multiple disc clutch built into headstock.

LeBlond's 16" and 18" Hollow Spindle Lathes for casting and oil drilling equipment. For any other metal turning requiring a large opening through the spindle. Simple operation with precision results. Now fitted with flame hardened steel bed ways. Also available in 27" and 30" sizes.

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of illustrated bulletin describing all four sizes of LeBlond Hollow Spindle Lathes. Write Dept. HS-14.

LEBLOND

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Pointers for Plastic-Mold Makers—IV

thermal expansion may cause cracking, particularly in thermosets.

COMPOUND SHRINKAGE

(Cold Mold to Cold Piece)	In. per In. (average)
Phenolic—wood flour filler	0.006-0.010
—fabric filler	0.003-0.007
asbestos filler	0.002-0.006
Urea	0.006-0.010
Cellulose acetate	0.002-0.010
Polystyrene	0.001-0.003
Methyl Methacrylate	0.002-0.006

Holes and Undercuts

Long slender holes require thin mold pins which are subject to heavy stresses and are to be avoided. Distance between hole and any insert should be at least 1/32 in. and about 1/16 in. between any two holes. Holes molded with threads are not satisfactory for engaging metal. Holes smaller than 1/16 in. should be drilled, not molded.

1. Holes at right angles to each other should be avoided if possible as they require split molds.

2. Oblique holes and re-entrant curves require special molds and should be avoided. Holes and undercuts should be designed to permit easy part removal from the mold.

3. Holes of 3/32 in. or less should be at least one diameter from the wall, larger holes have a smaller allowable ratio of wall thickness.

4. Through holes are easier to mold than blind holes. Blind holes should be limited to a depth of twice their diameter, or once their diameter if less than 1/16 in.

Threads

Threads may be molded integral with part, tapped after molding or molded in two sections with the flash and parting lines being removed with a sizing die. In small tapped holes no more than 68% thread is possible and fit cannot be closer than Class 11.

1. Threaded metal inserts should be used where frequent dissembly is required, and an adequate number of threads provide a tight seal.

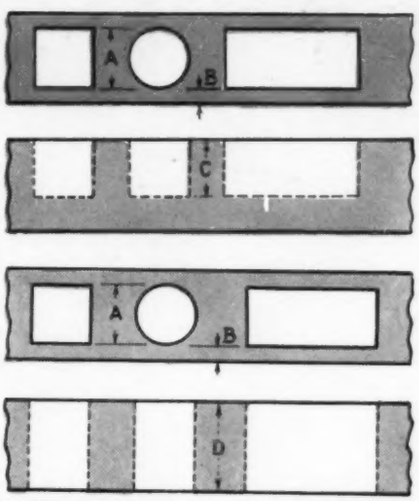
2. Threads are more difficult to mold in high impact material than in general-purpose types.

3. Molded threads should be started at least 1/32 in. from the end of face perpendicular to axis of thread to eliminate feathering.

4. Threads should end in a major diameter shoulder.

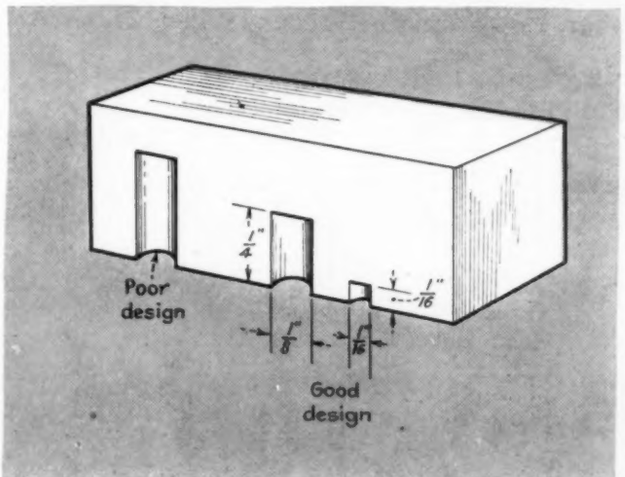
5. Pitch should be as large as possible to provide maximum engagement for strength.

6. Threaded holes should be countersunk to facilitate entrance and withdrawal of tap.

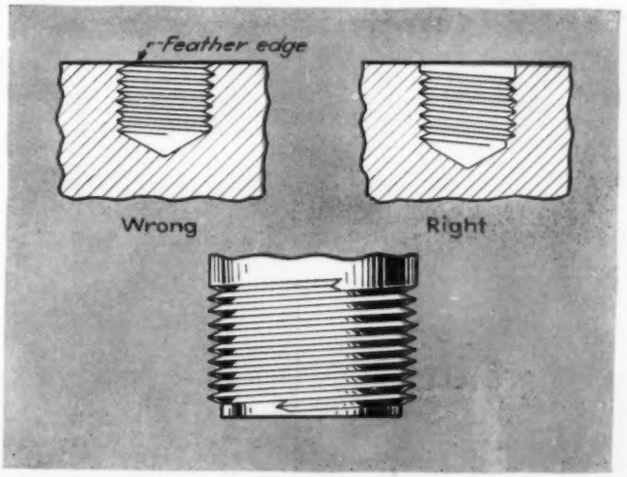


ALLOWANCES — MOLDED HOLES (IN)

Min. Hole Dia.	Max. Hole Dia.		Min. Sidewall Hot-Molded
A	C	D	B
1/16	1/16	1/8	1/16
5/64	3/32	3/16	1/16
3/32	1/8	1/4	1/16
7/64	5/32	5/16	3/32
1/8	3/16	3/8	3/32
5/32	1/4	1/2	3/32
3/16	5/16	5/8	1/8
7/32	3/8	3/4	1/8
1/4	7/16	7/8	1/8
5/16	9/16	1 1/8	5/32
3/8	11/16	1 3/8	5/32
7/16	13/16	1 5/8	3/16
1/2	15/16	1 7/8	3/16



Internal undercuts are impractical but where they are necessary, two sections may be assembled by cementing metal fastenings. Simple undercuts may be machined



Feather edges are to be avoided, molded threads starting at least 1/32 in. from the face. Threads should also terminate abruptly in a shoulder of major diameter

RED
"NOT GO"
Pat. Pending

GREEN
"GO"

~~NEW TESTED~~-ACCEPTED THREAD RING GAGES

5-PLUS FEATURES

1. Greater accuracy and stability
2. Longer wear life
3. Less weight
4. Positive identification
5. Positive adjustment

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WOODWORTH RING GAGES STILL PROVING "ON THE JOB" SUPREMACY OVER ORDINARY GAGES

No wonder more and more industries are adopting this gage as standard. Its revolutionary design assures wear life 5 to 7 times longer. And maintains accurate inspection.

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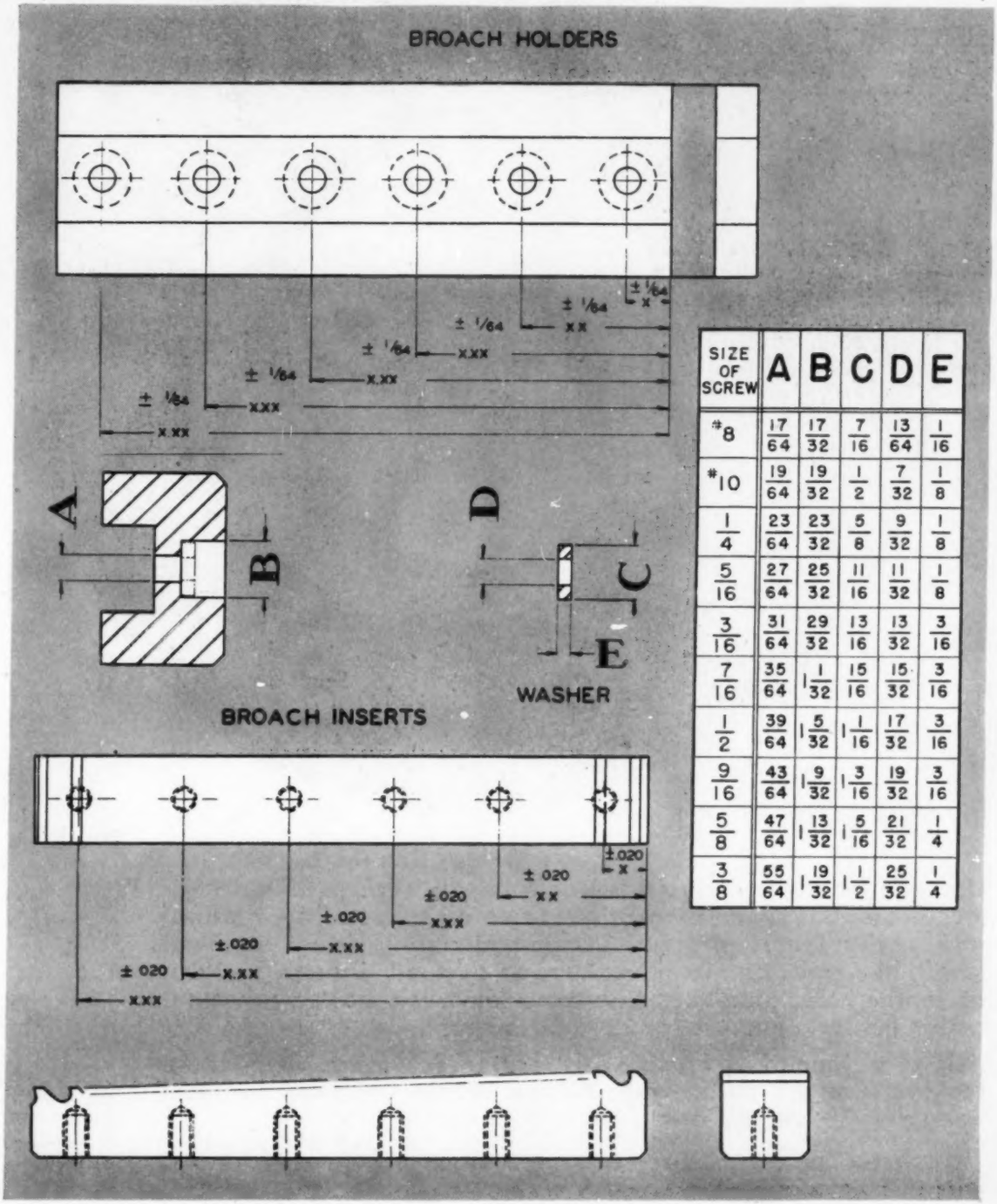
PRECISION GAGES • PRECISION MACHINE PARTS • DIAPHRAGM CHUCKS • ADJUSTABLE CLAMPING JIGS • SPECIAL TOOLS

Screw Holes for Broach Inserts and Holders

THE Broaching Tool Institute has adopted this standard for dimensioning screw holes and washers for broach inserts and holders. The primary consideration in development of the standard was to permit the best heat-treatment without the restriction of controlling location of holes because of growth. A broad tolerance is therefore applied to center distances of holes in broach inserts and holders. To accommodate this variation in center distances, holes in the holders are made sufficiently large and washers are used to compensate for the difference. Some adjustment is thus available in all directions when salvaging worn inserts, and to insure interchangeability of inserts in holders made independently.



SIZE OF SCREW	A	B	C	D	E
#8	17/64	17/32	7/16	13/64	1/16
#10	19/64	19/32	1/2	7/32	1/8
1/4	23/64	23/32	5/8	9/32	1/8
5/16	27/64	25/32	11/16	11/32	1/8
3/16	31/64	29/32	13/16	13/32	3/16
7/16	35/64	1 1/32	15/16	15/32	3/16
1/2	39/64	1 5/32	1 1/16	17/32	3/16
9/16	43/64	1 9/32	1 3/16	19/32	3/16
5/8	47/64	1 13/32	1 5/16	21/32	1/4
3/8	55/64	1 19/32	1 1/2	25/32	1/4

Get more tonnage for your snagging wheel dollar

Simonds Abrasive resinoid bonded wheels with patented Red Streak Flanges speed up production on all types of floor stand and swing frame grinders. Easier mounting (steel against steel), less wear on mount centers, no chipped sides and edges at center hole, plus better balance for truer, better grinding action result in greater tonnage, lower cost.

Ask any Simonds Abrasive Distributor for more details on resinoid bonded Red Streak Flange Wheels or send for our Snagging Wheel Bulletin.

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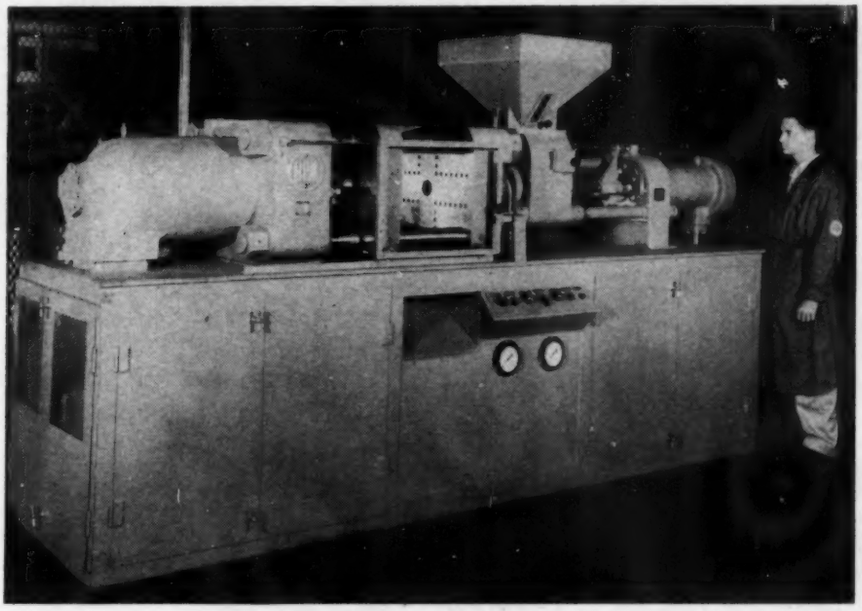
Shop Equipment News

Hydraulic Press Plastics Molder Injects 4 oz., Has Gravity Feed



A hydraulic bypass arrangement, which eliminates stop collars on the tie rods, limits forward mold-clamp travel on this plastics-injection machine

The Model 125-H-4, a 4-oz. plastics-injection machine, has been announced by The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio. The machine has a simplified construction and is more powerful and faster-acting than the earlier model.

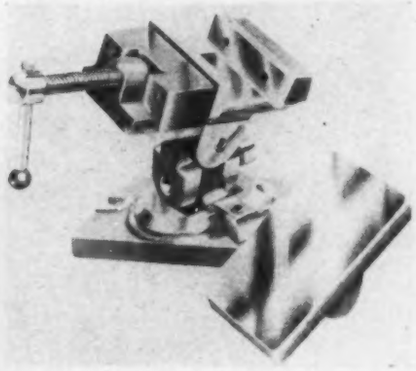
A self-contained power system is mounted in the base. It is driven by a direct-connected 15-hp. motor and provides a working pressure of 2250 psi. It has a single gear pump working in conjunction with a Hydro-Power pressure booster.

The gravity feed system utilizes a 50-lb. capacity lightweight hopper which is hinged at the base for access to the feed chamber and for cleaning. Sprues and gates may be fed directly into the chamber. A self-compensating feed mechanism automatically provides the correct amount of material.

An internal booster ram provides rapid mold closing, while the double-acting main ram gives 125-ton sealing force to the mold. Automatic slow-down of the mold clamp at predetermined position is adjusted by rotating a nut at the end of the cylinder to change the position of pressure shift from the booster ram to the main ram. The clamp ram closes at 530 ipm., opens at 355 ipm.

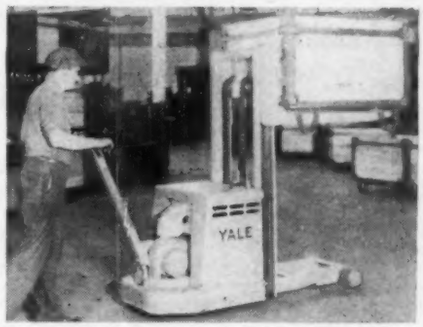
The injection ram opens at 475 ipm., and the injection plunger has a capacity of 527 cu. in. per min. at 20,000 psi. Handwheel valves adjust injection speed and pressure.

Vertical mounting between tie rods permits 15½ × 21-in. molds. Horizontal mounting permits 12 × 24½-in. molds. The injection chamber has a 3-kw. multiple zone-heating system. The diehead can be moved hydraulically to provide access to the heating chamber, and material can be injected into the atmosphere without entering the mold.



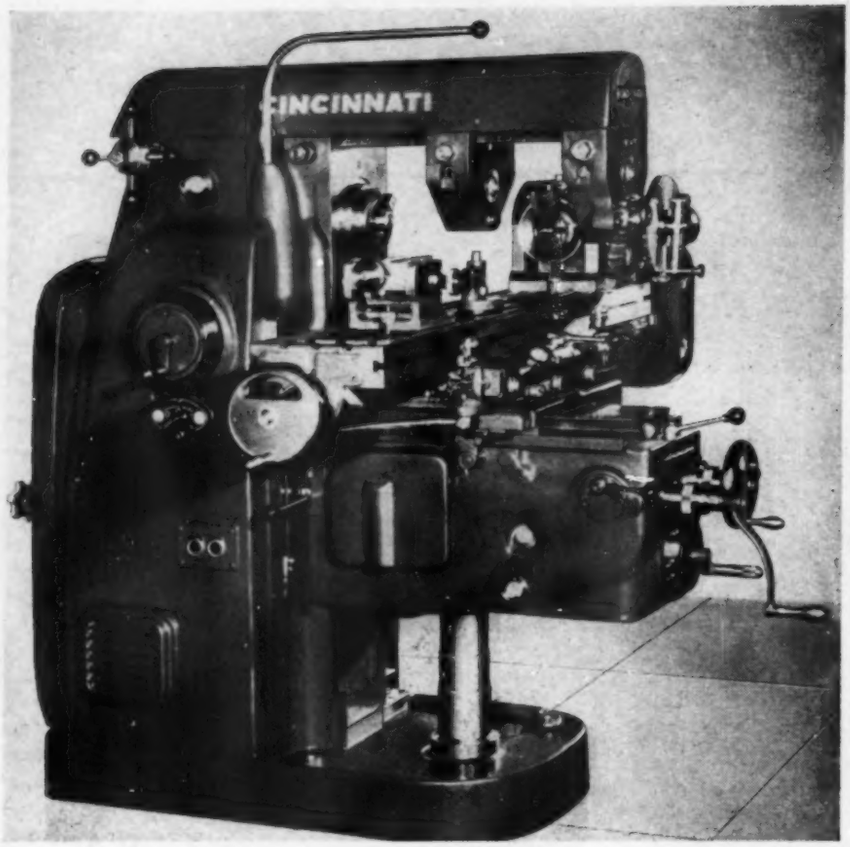
VISE—Multi-angle vise and worktable made by Manufacturer's Engineering Service, 400 Security Bank Bldg., Toledo 4, Ohio. Interchangeable, reversible vise jaws are 3x1 in., open 2 in. Vise and 4x5-in. worktable tilt 45° or more. Both mount on 4x6-in. 360° swivel base

Yale & Towne Power Handtruck Lifts and Stacks Loaded Skids



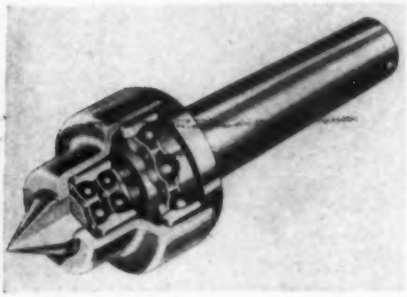
An electrically powered handtruck has been developed by The Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia 24, Pa. Available in two models, the truck is designed so that loads may be lifted and stacked. The electric power provides lift and movement, while the operator steers.

One model gets under a 7-in. skid and hoists it 66½ in. The other gets under an 11-in. skid and hoists it 70½ in. Both have a 4000-lb. capacity and can negotiate 54-in. aisles and 9% grades.



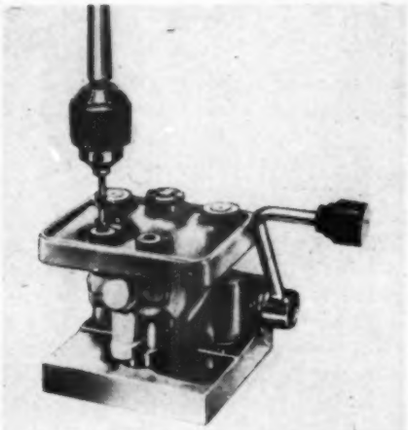
MILLER—No. 2 ML, built by Cincinnati Milling and Grinding Machines, Inc., Cincinnati 9, Ohio, is companion machine to No. 2 MI, announced last year. No. 2 ML, offered in plain and universal styles, is 1000 lb. lighter, is driven by 3-hp. motor (instead of 5-hp.) and has same general features as No. 2 MI (see AM, Aug. 1, 1946, p. 149). Speed and feed ratios are 60:1 and 120:1. There are 16 spindle speeds from 25 to 1500 rpm., and 16 feeds from 1/4 to 30 ipm. Rapid traverse is 150 ipm. longitudinal and cross, and 75 ipm. vertical

Sturdimatic's Live Center Compensates for Expansion



A live center with a replaceable alloy-steel point has been announced by Sturdimatic Tool Co., 5216 Third Ave., Detroit 2, Mich. The point is ground true with the bearings.

Low overhang and a slight cushioning action compensate for expansion due to heat, shock and excessive thrust loads. The thrust bearing is designed to take all the thrust load, and the radial bearing takes only the radial load. Standard shanks have Morse tapers.



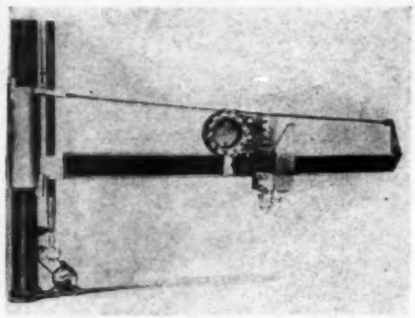
DRILL-JIG VISE—Unit holds pieces to be drilled, chamfered, tapped or counterbored. Top plate swings 180° to permit insertion of work, is locked by crank-type locking handle when swung back. Interchangeable top plates available from manufacturer, Lift-Swing Fixture Corp., 237 South Ave., Garwood, N. J., are said to be quickly installed on the vise

Bradford 660 Overhang Buffer Handles Long and Deep Work

The Model 660 heavy-duty overhang buffer is produced by Bradford Machine Tool Co., Cincinnati 4, Ohio. Especially designed for long and deep work requiring maximum clearance, the buffer is belt-driven by a ball-bearing motor at 2400 rpm. (or to specifications).

The model is in a power range from 3 to 20 hp. Belts may be changed without removing housing from shaft, and the buffer is equipped with a positive shaft lock, magnetic starter, overload protection and under-voltage release.

Mark F. Gouran Arc Positioner Has Lincolnweld Head, Carriage

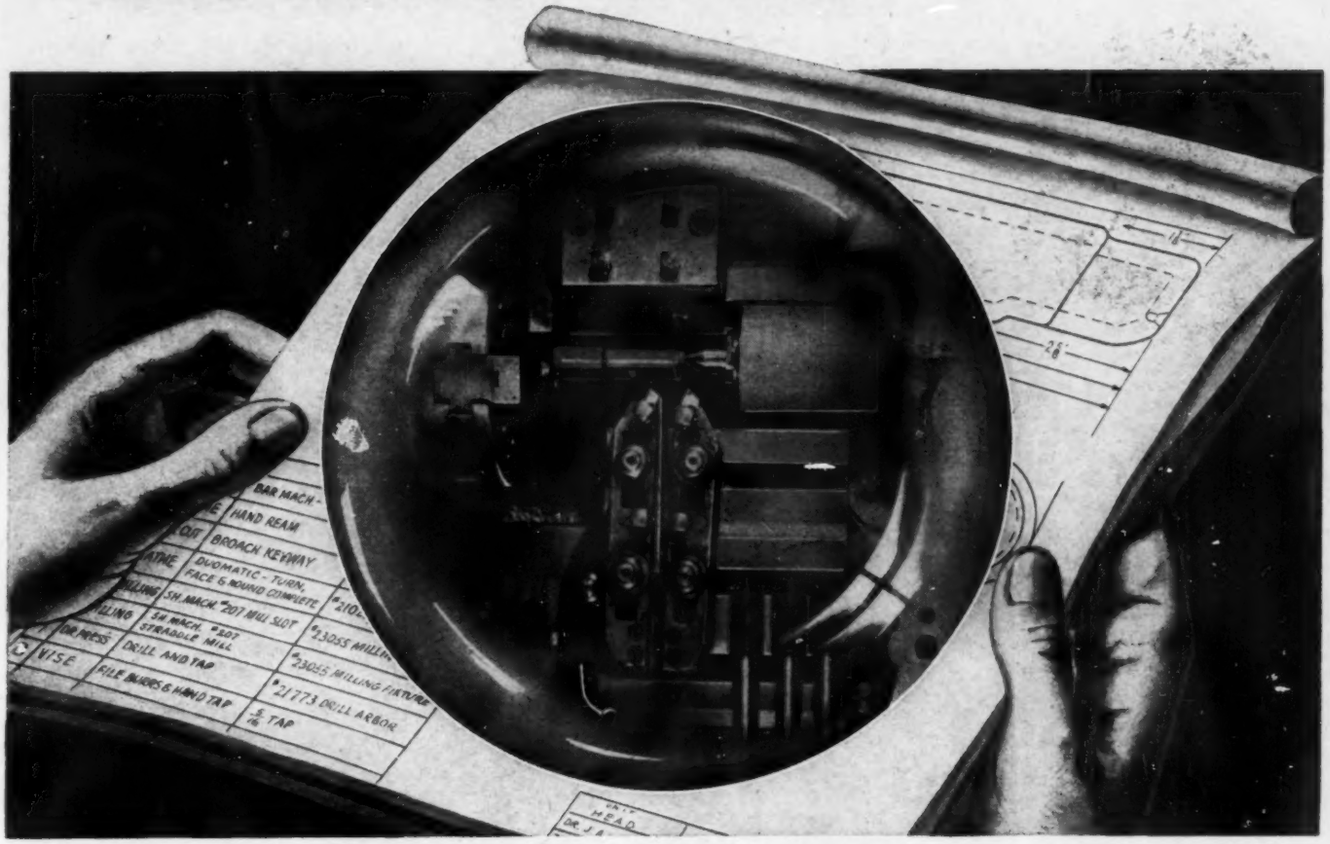


The "Arc Positioner," developed by Mark F. Gouran, Welding Engineer, 7426 Devon St., Mt. Airy, Philadelphia 19, Pa., is designed to provide greater mobility and save time in automatic shielded-arc welding.

The unit is comprised of an automatic shielded-arc welding head traveling on a beam encompassing a vertical zone of 8 ft. The assembly rotates around the fixed axis with a radius of 10, 15 or 20 ft., depending on which of three sizes is specified.

The traveling assembly is made by The Lincoln Electric Co., Cleveland, Ohio. It consists of the "Lincolnweld" head and carriage. Vertical operation of 36 ipm. is powered by a motor-driven adjustment on the beam, and the beam may be swung 360° about its axis.

TURN TO THE FUTURE . . .

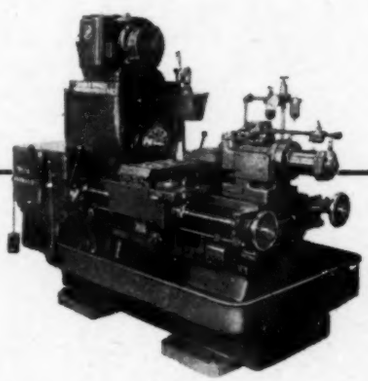


WITH LODGE AND SHIPLEY LATHES

● "It's clear as a crystal . . ." say Lodge & Shipley owners, ". . . Lodge & Shipley Engineering Foresight pays off in a wider range of job possibilities . . . more production . . . more profits!" Authentic production figures back up this statement. In one plant, to set up and run a 500 piece shaft job took 55 hours. The same job was set up and run on a Lodge & Shipley 2A-Duomatic (automatic lathe) in just 18 hours . . . almost 70% savings!

Features built into every Lodge & Shipley Lathe, permit the widest possible use . . . the greatest possible profit . . . are major weapons in cutting competitive costs.

Plan now . . . let a Lodge & Shipley Engineer project the profit possibilities of your present equipment against rising operating costs. Write for Bulletins 634 and 635 on 2A and 3A Duomatic Lathes.



THE Lodge & Shipley COMPANY

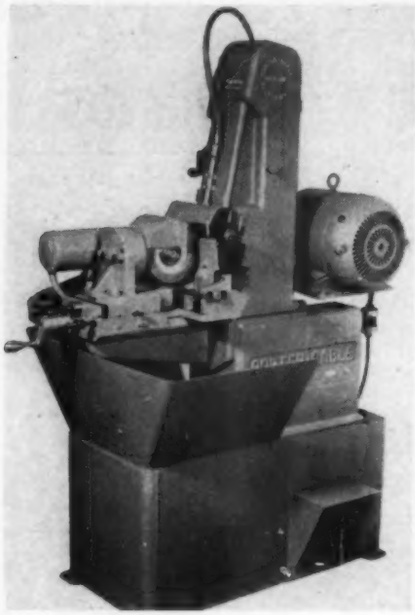
CINCINNATI 25, OHIO

MACHINE TOOL DIVISION • 3055 COLERAIN

SPECIAL PRODUCTS DIVISION • 800 EVANS ST.

GOGGLE—The Speedframe, a self-adjusting welders' goggle, is announced by Mine Safety Appliances Co., Pittsburgh 8, Pa. A nod of the head raises or lowers the goggle, leaving operator's hands free for work. The Speedframe can be furnished with welders' or chippers' goggles, with or without Coverglas lenses

Porter-Cable Centerless Grinder Keeps Work Cool with Wet Belt

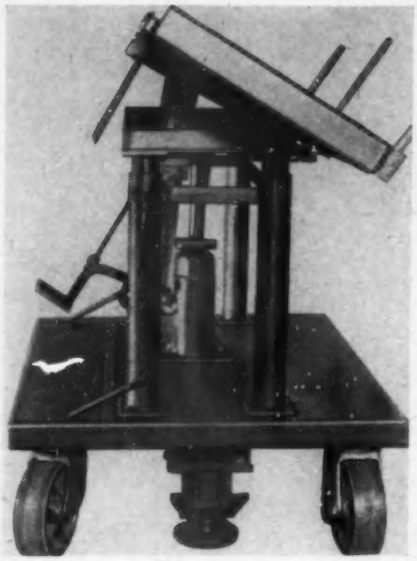


A centerless wet-belt grinder has been added to the line of Porter-Cable Machine Co., Syracuse 8, N. Y. The machine handles work from ¾ in. to 2 ft. long (and longer if proper supports are used) and ranging from 3/32- to 2¼-in. dia.

An endless abrasive belt operates over a contact roll. The roll is resilient to follow work and eliminate chatter, and it is balanced with the abrasive belt. Work is done by the belt, so the contact roll gets little, if any, wear, and its diameter remains constant. This cuts down on truing and balancing operations and simplifies set-up.

Grinding is done below center to avoid throwing the work out of the machine, and when the belt breaks, it simply drops off of the machine. The wet belt keeps the work cool to avoid distortion and warping.

Rack Hydraulic Feed Table Conveys 3- to 10-ft. Sheets



A hydraulic feed table conveyor is manufactured by Rack Engineering Co., Dept. B, 5102 Butler St., Pittsburgh 1, Pa. The table has a 1 to 5-ton capacity and can handle sheets 3 to 10 ft. long.

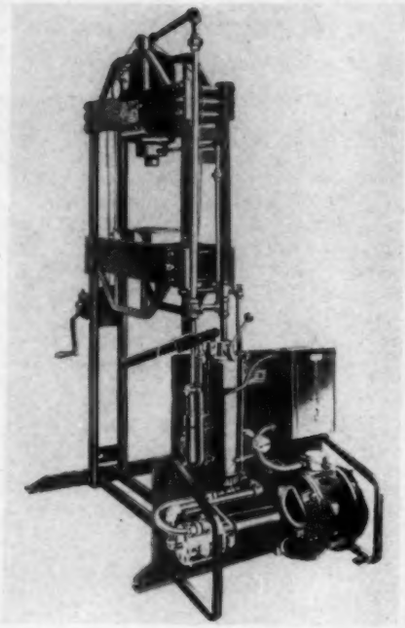
The pedal-operated hydraulic mechanism enables the operator to raise or lower the load to precise levels and to control the angle of the table top through its 40° range. When tilted to working position, the top is locked by pins at both ends and the operator's hands are left free for loading sheets from the table onto dies.

The table has 6-in. roller-bearing casters, two of which swivel. A heavy-duty floor lock insures stability in working position.

K. R. Wilson Arbor Presses Handle Work for Short Runs

A line of motor-driven hydraulic arbor presses of 25-, 50-, 60-, and 75-ton capacity is made by K. R. Wilson, Buffalo 2, N. Y. The presses are designed to relieve heavier presses of short runs or small work.

The frame is a weldment, and press dimensions can thus be changed to meet special requirements at low cost. The bed is raised or lowered by means of a cable, drum and crank, and operation of the ram is controlled by a motor valve control actuated by finger and thumb.



The motor-driven hydraulic pump is a Seco radial type of 3000 to 10,000 psi. capacity. All units are equipped with a KRW pressure by-pass valve which permits required tonnage to be accurately set and maintained. A spring-actuated quick-return ram instantly returns the ram to "open" position.

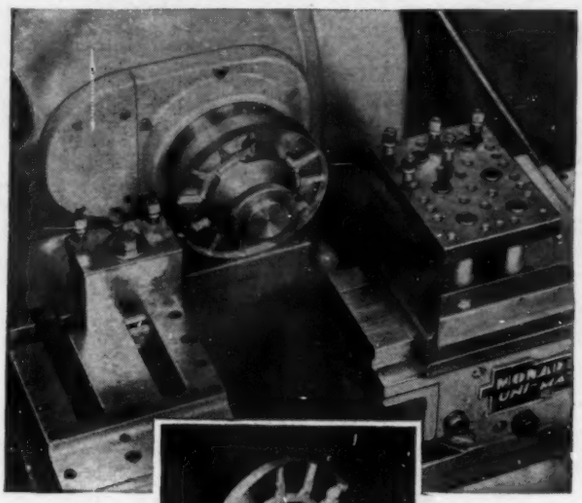
The KRW drive units can also be used to convert existing KRW hand-operated presses to hydraulic units.

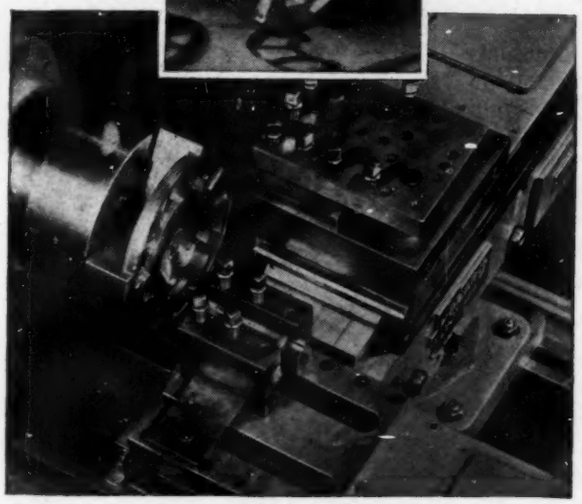
Airdraulics SDB-25 Beam Scale Checks Torque-Tool Accuracy

The Model SDB-25 beam scale has been announced by Airdraulics Engineering, Inc., New Canaan, Conn. The device checks accuracy of torque tools including screwdrivers and wrenches, and it tests and adjusts power tools.

The scale has a capacity to 25 in-lb. and is accurate to a fraction. It can be made to suit special applications with adapters, and larger-capacity devices can be supplied.

3 Uni-matic Keys to Profitable Production...





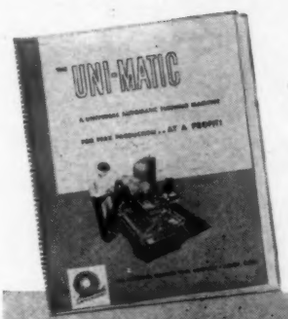
Here's high-speed metal turning at its best!

The Uni-Matic is Monarch's new single-spindle automatic chucker—the machine that brings *peak production at a profit* within reach of every shop, no matter how large or how small the lots.

You can synchronize the independent motor-driven tool slides for simultaneous operation. Floor-to-floor time becomes little more than the time for the longest single cut. With a completely automatic cycle and rapid Uni-Mat traverse, there's no time lost traversing to or away from the work. Speed ranges are ample; speed changes quick—there's no excuse for using any but the most efficient cutting speed. And you can stop dead in *one second*, even with a spindle speed of 3,000 rpm.

When you want efficient, high-speed metal turning capacity, on parts as small as 1" and up to 16" diameter—plus universal adaptability to meet today's rising production costs—you'll want to investigate the Monarch Uni-Matic.

THE MONARCH MACHINE TOOL CO. • SIDNEY, OHIO



THE PART—Cash register key frame; cast iron, 6¼" O.D.

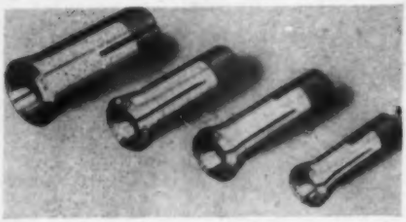
THE PRODUCTION FACTS—First operation—Face, bore and groove; time—1.00 minute. Second operation—Turn O.D. and face opposite side; time—1.10 minutes. Total time—2.10 minutes, including 20% fatigue factor.

For "peak production at a profit", get your copy of this new 36-page catalog on the Monarch Uni-Matic.

ACCURACY - ECONOMY - LONG LIFE

Monarch TURNING MACHINES

South Bend Draw-In Collets Can Be Rebored When Used



A line of brass precision draw-in collets has been announced by South Bend Lathe Works, 378 E. Madison St., South Bend 22, Ind. The collets can be rebored to larger diameters when used and can be machined to hold tapers or irregular shapes.

The collets can be obtained in fractional sizes from 1/16 in. up to the maximum capacity of the collet in 1/64-in. increments. In decimal sizes they vary from 0.0625 in. to maximum capacity, and in metric sizes from 1.5 mm. to maximum capacity in ½-mm. increments. They are primarily for South Bend lathes.

Bryant Squareness-of-Face Gage May Be Mounted on Thread Gage

A squareness-of-face gage to check the relationship between the pitch diameter of a thread and the face of the part has been announced by Bryant Chucking Co., Springfield, Vt. The gage may be mounted on any Bryant thread gage, and it consists of a movable arm which carries a dial indicator and two adjustable contact points to cover the capacity of the thread gage.

The front contact actuates the dial indicator on the face gage, while the inner contact is a pilot to compensate for thread progression as the part turns during inspection. Various models cover capacities from ⅜- to 8-in. internal-thread dia.

Simonds Saw and Steel Simometer Measures Hacksaw-Blade Tension

The Simometer, a device which measures the tension of power-hacksaw blades, indicating the correct amount for maximum cutting efficiency, has been developed by Simonds Saw and Steel Co., Fitchburg, Mass.

The Simometer is attached directly to the blade and held by two thumbscrews. As tension is applied, a pointer indicates tension on the dial. When correct tension is reached, the Simometer can be removed and the job started. Said to increase blade life by as much as 15%, the device is designed to avoid the inaccuracies of conventional tightening devices.

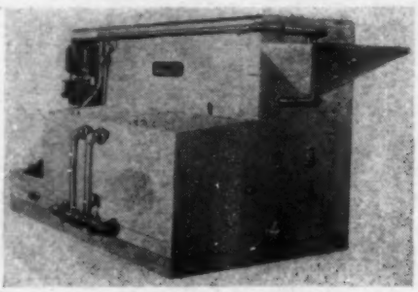
Improved Imperial Brass Fitting Connects Thin-Wall Metal Tubing

Improved brass fittings for connecting copper, steel, aluminum and other thin-wall metal tubing have been announced by The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill. The fitttings have forged bodies on elbows and tees and Dryseal pipe threads on the thread ends. In the ¼-in. sizes and over, the threads are longer than the old style threads and are designed to provide tight joints.

Rapids-Standard Adopts Durastan

The tradename "Durastan" has been adopted to designate the line of phenolic-plastic (Durez) caster wheels manufactured by The Rapids-Standard Co., Inc., Dept. DC 120, 308 Peoples National Bank Bldg., Grand Rapids 2, Mich. The wheels were formerly known as "MRK Resinoid" wheels.

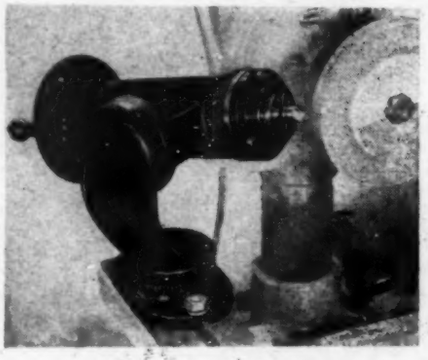
Optimus Screw-Drum Type Machine Washes and Dries Metallic Parts



A screw-drum type machine is announced by Optimus Equipment Co., 151 Church St., Matawan, N. J. It can be used for washing and drying metal parts, rinsing and drying them, or any part of these operations. It also can be adapted for a wash drain, rinse drain, cold- or hot-air dry, or for pickling.

The dryer end is completely enclosed to prevent air loss, and the heater and blower provide either hot- or cold-air blast. All parts of the machine are readily accessible for lubrication or maintenance.

Machine Products Relief Grinder Handles 1/16- to 1-in. Dia. Work



The Model 100-B, an I-G-C relief grinder, has been added to the line of Machine Products Co., 1640 S. Hobart Blvd., Los Angeles 6, Cal. It is designed to handle countersinks, center drills, integral pilot cutters and pilot drills, right or left hand. It can be used in small tool-cutter grinding.

The mounting knee has been redesigned so that the working head can be set at any angle, and the head has built-in indexing pins. The 100-B fits any standard grinder and handles work from 1/16- to 1-in. dia. with standard collets. Lift of the single cam is from 0.001 to ⅛ in. The adjustment pins are provided for 1-, 2-, 3-, 4- and 6-fluted cutter grinding.

5 REVERE METALS Meet Strict Lock Requirements

★ ★ ★

Here is an example of the manner in which the wide variety of Revere Metals permits exact specification. In the manufacture of this lock *five* Revere Metals are employed. Here they are:

1. 70-30 Cartridge Brass for the dial flange
2. Commercial Bronze, 90%, for case, case lid and bolt
3. Heavy Leaded Brass for tumbler parts and other items, including dial, requiring exceptionally accurate machining
4. Free Cutting Brass in Rod and Extruded Shape, for the machined and knurled head, and for the angle bar
5. Forging Rod, for the tumbler driver

Selection and employment of these metals enabled the manufacturer to meet the many different requirements of fabrication methods, and at the same time assure strength, long life and reliable operation. Revere Metals perhaps can do as much for your own product. For cooperation in the choice and use of these metals, ask about the Revere Technical Advisory Service. Revere supplies mill products as follows: *Copper and Copper Alloys:* Sheet and Plate, Roll and Strip, Rod and Bar, Tube and Pipe, Extruded Shapes, Forgings —*Aluminum Alloys:* Tube, Extruded Shapes, Forgings —*Magnesium Alloys:* Sheet and Plate, Rod and Bar, Tube, Extruded Shapes, Forgings.

REVERE

COPPER AND BRASS INCORPORATED

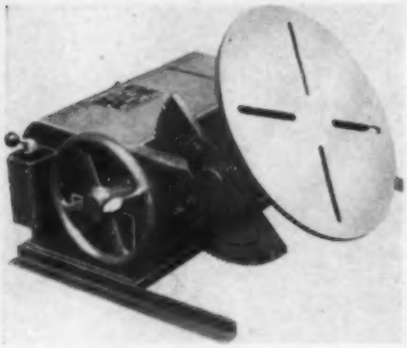
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Mosler combination lock, most of its parts fabricated of Revere Metals. Made by The Mosler Lock Company, Covington, Ky., the lock manufacturing division of The Mosler Safe Company, largest builders of safes and vaults in the world.

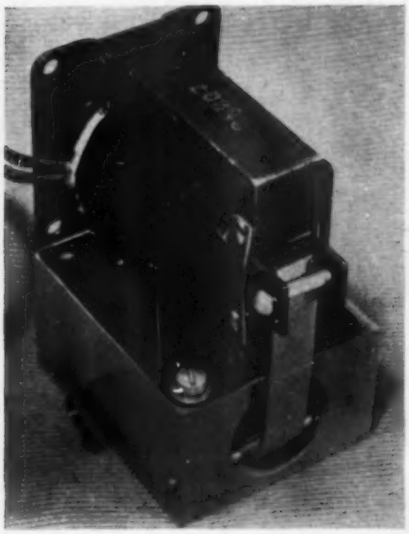
Ransome Bench-Model Positioner Revolves Work by 1/8-hp. Motor



A power-operated bench-model positioner has been introduced by Industrial Div., Ransome Machinery Co., Dept. P-5, Dunellen, N. J. Designed for 100 lb. work, or less, the Model 1-P facilitates welding, assembling, grinding and similar operations.

Work may be tilted to 135° and locked in position. It may be revolved 360° by a ⅛-hp. single-phase reversible motor. A lever-operated variable-speed pulley gives a speed range from 0.21 to 5 rpm. A disengaging clutch permits free wheeling.

Electrol Two-Way Solenoid Valve Gives Continuous-Duty Operation



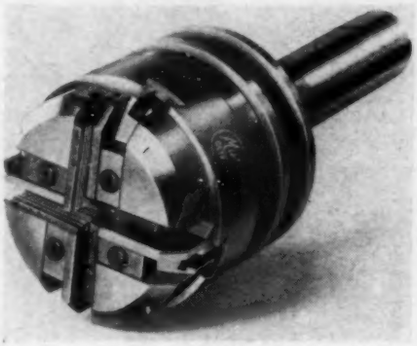
A 110-v. ac. solenoid two-way valve for machines where continuous duty is desired is announced by Electrol, Inc., Kingston, N. Y. The unit accommodates operating pressures up to 1500 psi., or higher if required, and though primarily for use with oils, it can be adapted for other fluids. It comes in NPT sizes of ⅛, ¼, ⅜ and ½ in.

All exposed metal parts are protected from corrosion, and the valve can be supplied with normally closed or normally open position. The valve weighs 1¾ lb., has two mounting holes and two 10-in. lead wires.

Correction: In the description of the hole locater made by Knu-Vise, Inc., (*AM*, Mar. 13, p. 170) the street address was incorrect. The company is located at 2217 Eighth St., Detroit 16, Mich.

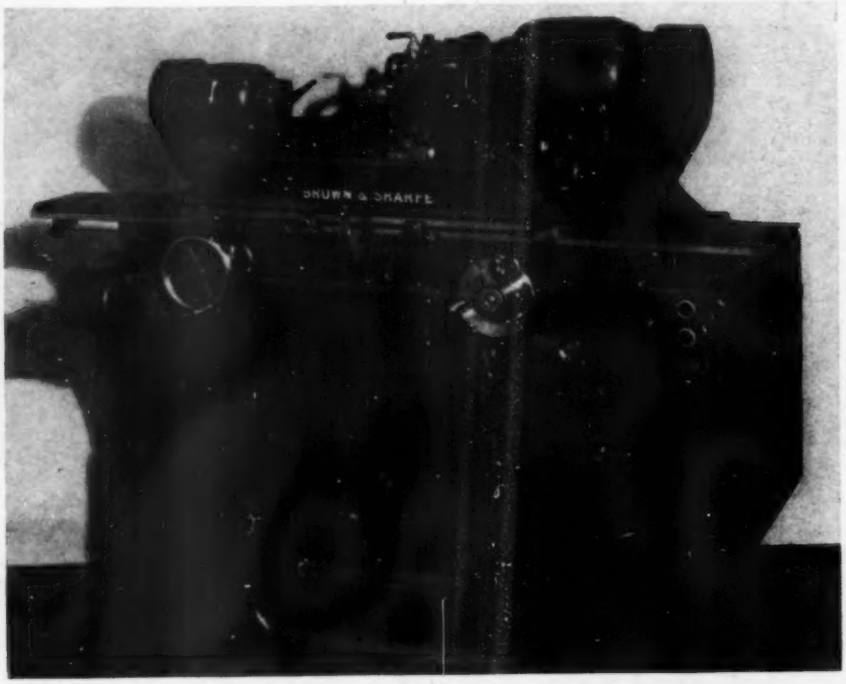
SAFETY GOGGLE—A lightweight all-plastic safety goggle with air-conditioned eyecups to reduce fogging of lenses is made by American Optical Co., Southbridge, Mass. The A-O Panoram goggle protects eyes on jobs such as chipping, grinding, riveting

Murchey Tangent-Chaser Dieheads Take Place of Two or More Setups



Tangent-chaser dieheads have been developed by Murchey Machine and Tool Co., 951 Porter St., Detroit 26, Mich. Interchangeable chasers and chaser-holding blocks can be removed and replaced without removing the tool from the machine. Thus one diehead with extra blocks and chasers takes the place of two or more complete setups.

Dieheads are furnished in stationary and revolving types. Type TRB, a rotating yoke-operated tool for screw machines, drillpresses or other machines requiring revolving tools, is illustrated.



GRINDING MACHINE—The electrical controls on the No. 5 plain grinding machines, built by Brown & Sharpe Mfg. Co., Providence 1, R. I., are now fully enclosed in a compartment on the right side of the machine. One push-button on the outside of the compartment controls starting and stopping of the motors for the entire machine. Magnetic controls, individual-motor overload relays, transformer for control system and mainline disconnect switch are mounted inside. When the lever on the door is turned to open, a safety device operates the mainline disconnect switch and shuts off the current

...by insisting on AMERICAN PHILLIPS SCREWS

PRODUCTION-WISE – add sunlamp manufacturers to the host of stove, refrigerator, furniture and other modern-minded makers who are cutting production costs via American Phillips Screws. How? By straight, sure-fire, speedy, *automatic* driving that's proof against scars, scuffs, work spoilage. No matter what the pace, the 4-winged American Phillips Driver "stays put" — can't harm or hinder work or worker . . . and you can count on *time savings up to 50%!*

PROMOTION-WISE – American Phillips Screws lend a modern touch — step up the "sell" of whatever you make. They can't snag clothes but they *do* snag *orders!* Showmanship and serviceability both say "specify American Phillips."

4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

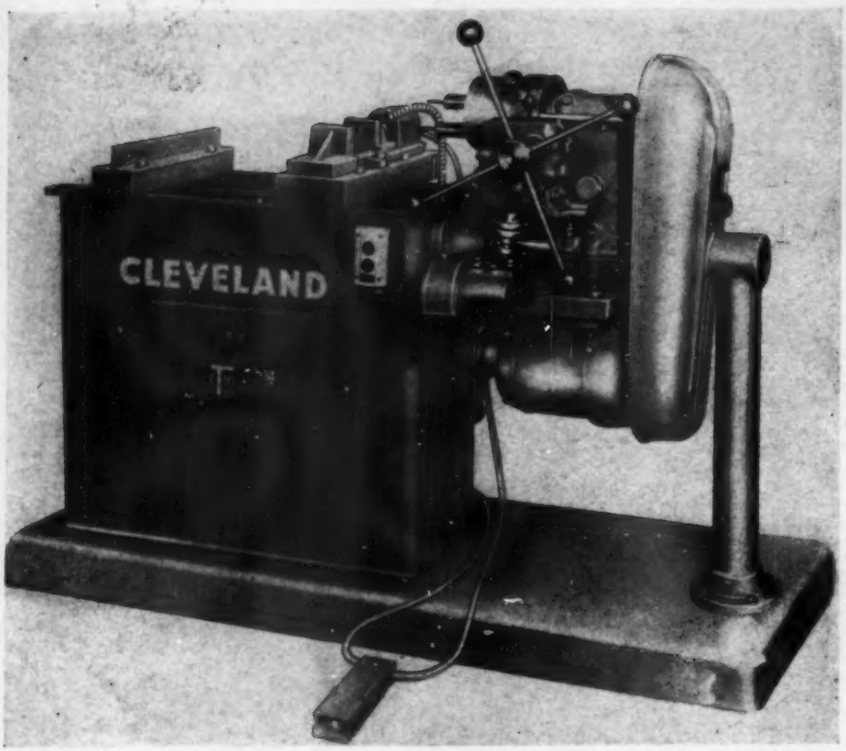
AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois St. *Detroit 2:* 302 Stephenson Bldg.

AMERICAN PHILLIPS *Screws*

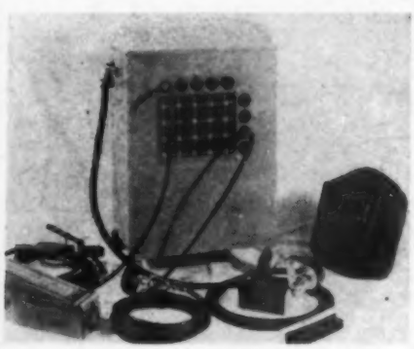
ALL TYPES

ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)



DRILLING AND TAPPING MACHINE—Horizontal machine developed by The Cleveland Tapping Machine Co., Hartville, Ohio, is designed primarily to drill and tap large copper anodes to receive hanging hooks, but is suitable for long, irregular work. A hand control indexes the head for consecutive drilling and tapping. Depth of hole and tool withdrawal are automatically controlled. An air-operated vise is standard, and in the illustration the vise is mounted on a special table which positions the work for a number of operations

Westinghouse Flexarc Welder Gives Two Striking Voltages



The Flexarc limited-input type welder is announced by Westinghouse Electric Corp., 306 4th Ave., Box 1017, Pittsburgh 30, Pa. A general-purpose transformer arc welder, it comes in output ratings of 130, 160 and 180 amp. The three models, WT-13, WT-16 and WT-18, have 20 steps of current adjustment from 20 amp. to rated maximum.

Two striking voltages, 65 v. for small electrodes on the lower half of the range and 50 v. for larger electrodes, are provided. Welder comes with line breaker, power cable, electrode holder and lead, electrodes, helmet, and other equipment.

Also announced is an improved Quicklag circuit breaker. It incorporates a new tripping action which combines the inverse time-limit characteristics of Bimetal thermal action on overloads with the operating speed of magnetic trip action on short circuits. It is available in single or double pole, 10 to 50 amp., 125 to 125/250 v. ac. Among other improvements, it has a redesigned "Deion" arc chute to eliminate the need for a vent screen in the bottom.

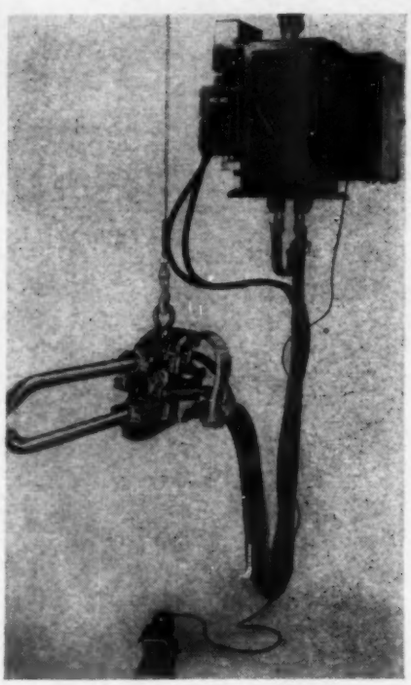
Yale & Towne Electric Truck Utilizes Roller-Ramp System

A gravity-tilting-platform type electric truck is announced by The Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia 24, Pa. Designed for manipulation of heavy machinery and crates, the truck utilizes a roller-ramp, cable-draw system.

The roller platform falls into ramp position when unlatched. Cables encircle the load, pull it on the ramp

and cause the ramp to rock back into horizontal position. Three cable-pulling levels may be used. The platform is balanced so that it may be easily rocked back and latched for empty return trips.

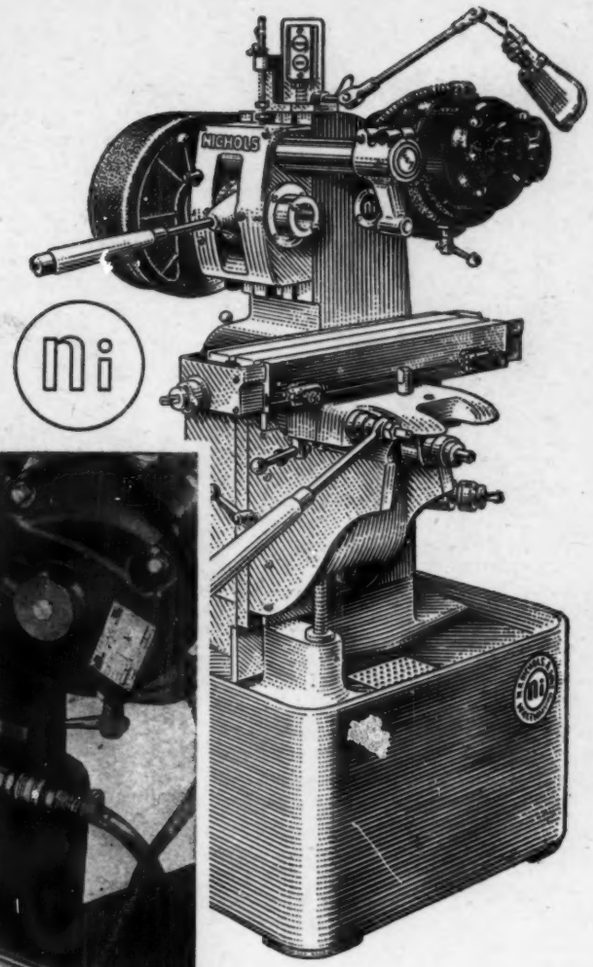
Eisler Rocker-Type Gun Welder Is Operated by Air Cylinder



A portable air-operated gun welder is produced by Eisler Engineering Co., Inc., 743 S. 13 St., Dept. 3, Newark 3, N. J. Suitable for spot welding light-gage sheet metal, the machine will weld heavier work when short holders are supplied. The drawn-copper horns can be exchanged to fit 8- to 24-in. throat depths, and rating of the welder is 30 to 75 kva.

A double-acting air cylinder is placed between the lever arms, and transmits pressure to electrodes by lever action. Welding cycle is initiated by foot switch or pushbutton. The power pack consists of an air-cooled transformer with 8-tap switch, a pneumatically or electronically actuated timer and a high-speed contactor which mechanically or electronically times the weld in speed or automatic repeat of stroke.

More power to you
More speed to you
More profit to you



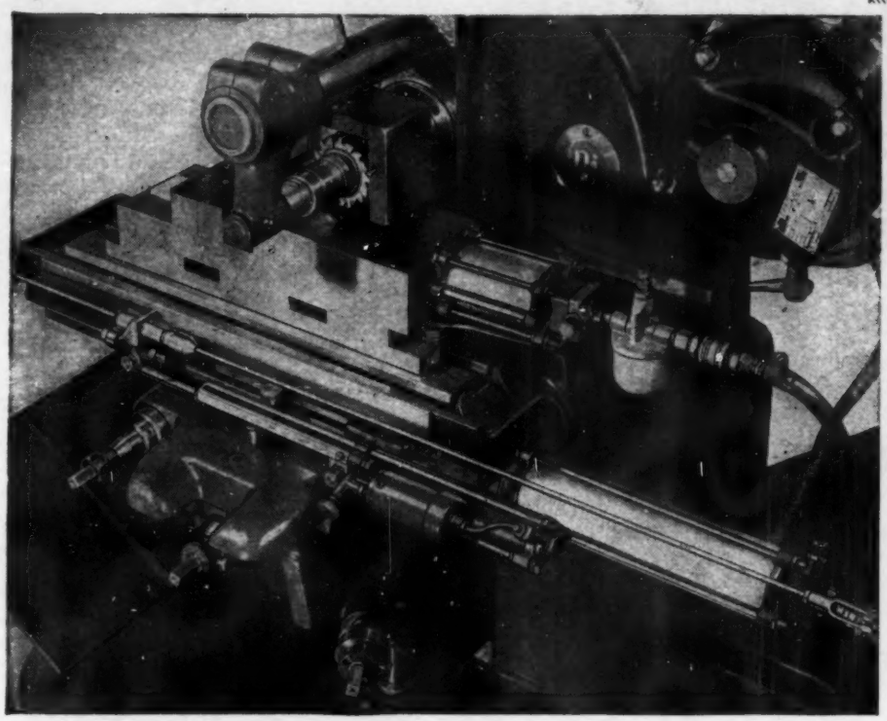


Photo shows Nichols power feed attachment installed. In this case, work is held in an air-operated vise

...with the *New Nichols* Power Feed Attachment

Here is a tested and proved power feed attachment that is an added production asset for *any* Nichols Miller. It is designed to reduce the time of the operating cycle and reduce the operator's duties so that often one operator can run two or more machines.

This power feed attachment is designed for fast table advance — maximum proper cutting feed — fast table return — automatic shut-off. It is completely automatic except for loading and unloading the work. Rapid traverse and work speeds are easily and quickly changed to suit all classes of jobs within the capacity of the machine.

Basically this attachment is a Bellows air feed unit used in conjunction with a Hydro-Check. Thus a positive, infinitely variable feed is obtained throughout the 9" maximum cutting stroke by using regular shop air lines with 75 to 175 lbs. pressure.

The Nichols power feed attachment can be installed either before or after shipment of the Nichols Miller. *It can be installed quickly on any Nichols Miller ever built.* Write for details.

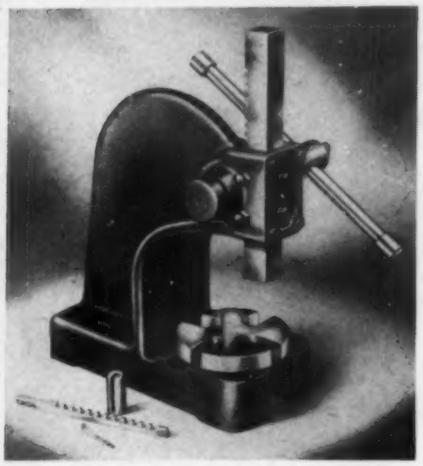
Send for free Nichols Miller Catalog

THE *Nichols* MILLER

MANUFACTURED BY W. H. NICHOLS & SONS, WALTHAM, MASSACHUSETTS

NATIONAL DISTRIBUTORS: NICHOLS-MORRIS CORP., 40 CHURCH ST., NEW YORK 7, N. Y.

Minute Man Keyway-Broach Kit Cuts Standard-Width Keyways



The Minute Man keyway-broach kit for hand cutting keyways of any standard width and any depth is available from The du Mont Corp., Greenfield, Mass. It cuts parts including gears, milling cutters, pulley hubs and couplings.

Broaches, bushings, shims and keyway stock are provided in the kit. The selected bushing is dropped into the bore of the arbor press. The broach is inserted in the slot in the bushing and is pressed through, using shims.

The arbor press is also available from du Mont and can be applied t other shop uses.

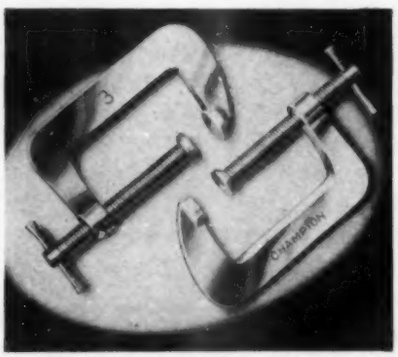
Reypo's Quick-Acting Vise Opens Jaws 1 1/8-in. Maximum

A quick-acting vise has been added to the line of Reypo Corp., 9900 Lincoln Blvd., Los Angeles 45, Calif. With an over-all height of 2 in., the vise has a 1¼-in. jaw width and a maximum jaw opening of 1⅛ in.

The machined dovetail slide with adjustable gibs prevents wobble. Both jaws have removable inserts, and the rear jaw can be set in two positions. Work may be released by turning the screw ½ turn, flicking a lock lever, and withdrawing jaw.

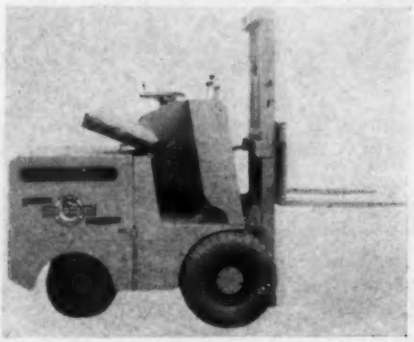
Accessories include a small hand vise with ⅞-in. jaw opening, a vise handle, swivel base and ball-base positioner.

TOGGLE PRESS — A single-point double-action toggle press is made by The Cleveland Punch & Shear Works Co., Cleveland 14, Ohio. The machine illustrated has single connection, 28-in. stroke with 6-in. adjustment, 500-ton capacity for inner slide and 300-ton capacity for outer slide. All gears and the drive unit are enclosed in the crown and there is an electrically controlled air-operated friction clutch. The press can be furnished in other sizes and with two connections



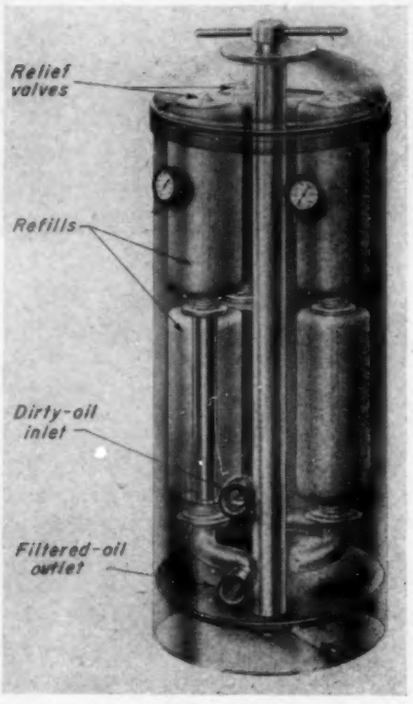
CLAMPS — Champion aluminum "C" clamps by The Western Tool and Mfg. Co., Inc., Springfield, Ohio, designed for high strength without sacrifice of lightness. Various sizes open from 2½ to 6 in. Depth from 1¾ to 2¾ in.

Crescent Model LGVH Palletier Lifts and Tilts Hydraulically

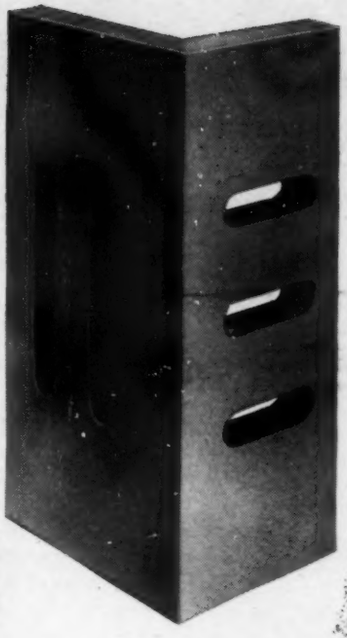


The electric Palletier, model LGVH, is made by Crescent Truck Co., Lebanon, Pa. With brakes mounted on the drive wheel, the LGVH has all controls available to the driver's fingertips, and spotting and tiering can be done without leaving the seat.

In the 2000-lb. capacity size, the truck has a magnetic-contactor controller. In the 1000-lb. size, it has a choice of cam-operation controller or magnetic controller. The truck has hydraulic lift and tilt.



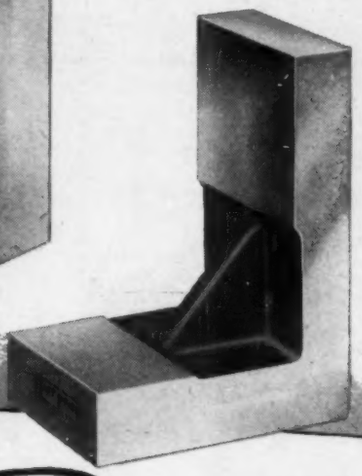
OIL FILTERS—A line of oil filters has been developed by Briggs Filtration Co. (formerly Briggs Clarifier Co.), Bethesda 14, Md. The illustration is of the model D-6-BR-SV2. Oil under pressure enters at the inlet, passes through the refill elements and out of the outlet connection. Oil (and air or foam) that does not go through refill elements, passes through relief valves

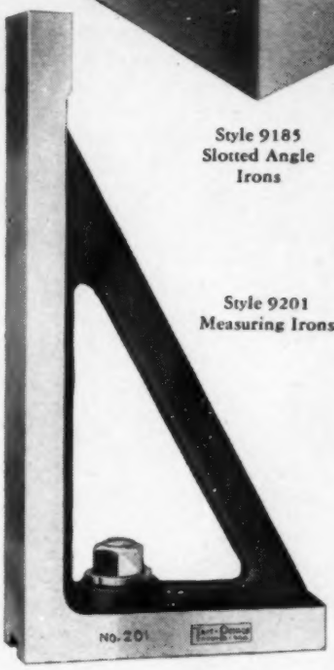


Style 9185
Slotted Angle
Irons

Style 9191
Universal Right
Angle Irons

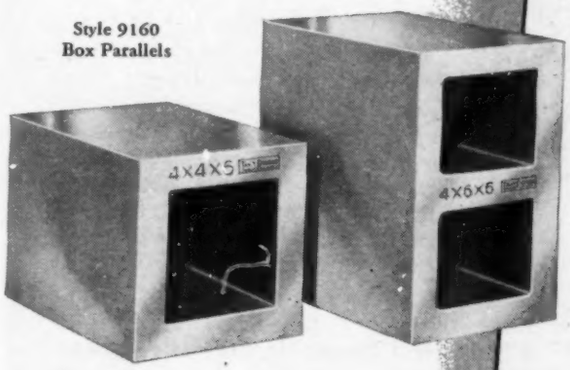
Style 9180
Toolmaker's Knee





Style 9201
Measuring Irons

Style 9160
Box Parallels



Speed

YOUR SET-UPS and LAYOUTS— Simplify Inspection Procedures with these

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Shop foremen and chief inspectors appreciate the convenience of Taft-Peirce Tool-Room Specialties in maintaining top standards of precision on large-volume production.

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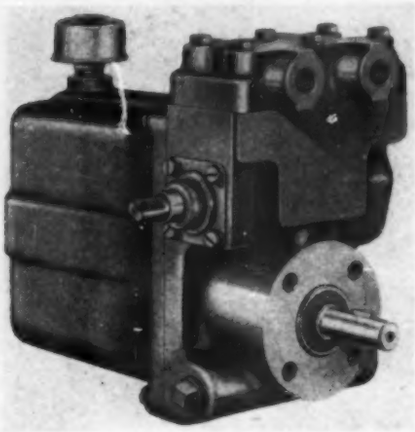
IN TOOLING, SET-UP AND INSPECTION . . .

T-P *means* TOP PRECISION

Parts and Materials

Vickers Hydraulic Power Pack Attached to Any Power Drive



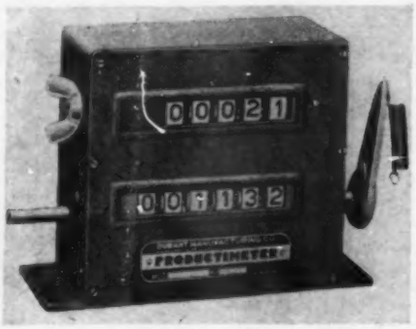
A hydraulic unit, the Power Pack, is made by Vickers, Inc., 1410 Oakman Blvd., Detroit 32, Mich. It is a self-contained "package" composed of a vane pump, relief valve, various combinations of single- and double-operating valves, an oil filter, air cleaner and oil tank. It can be attached to any power drive, directly, with V-belt, chain drive or gears. It weighs 45 lb.

The Power Pack can be used in power operation of machinery and materials-handling equipment. It develops pressures depending on cylinder size used. It is available with normal pump delivery of 2, 3 or 5 gpm. at 1200 rpm. and 1000 psi.

Alloy Rods Weld-Arc Electrodes Furnish Quiet Arc, Low Spatter

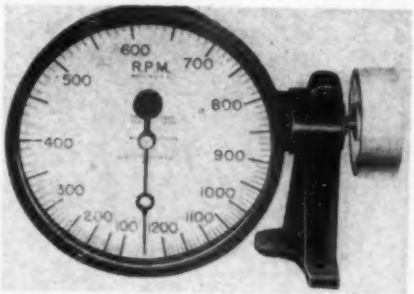
A line of mild-steel electrodes and low-alloy, high-tensile steel electrodes is announced by Alloy Rods Co., York, Pa. Known as the Weld-Arc line, the electrodes are manufactured in ten types: six for mild steel and four for low-alloy, high-tensile steel.

The electrodes are said to furnish low spatter loss, correct penetration, easy slag removal, high physical properties, quiet arc action and no underhead cracking. The different features of the individual rods are said to enable the line to meet any requirements for ac. or dc. welding.



COUNTERS—The "N" series double-deck Productimeters, which are rotary and stroke counters, are made in conventional and predetermined types by Durant Mfg. Co., 1929 N. Buffum St., Milwaukee 1, Wis. The rotary model is double-worm driven for high speeds, and the upper row of the stroke model is chain driven. The predetermined models have a simplified switch mechanism for light operations and a positive switch action at the predetermined count. The Productimeter is a register of current runs, and daily, weekly or monthly production totals

Zernickow Stationary Tachometer Adapted for High and Low Speeds

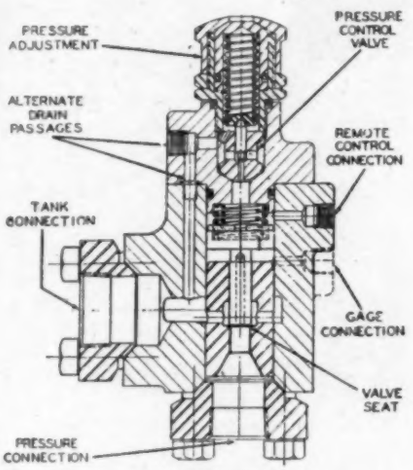


Improvements in the O-Z stationary tachometer are announced by O. Zernickow Co., 15 Park Row, New York 17, N. Y.

The tachometer now has greater free running and is more sensitive, without lag, to speed fluctuations. A thread is said to be sufficient to run it. Accuracy is guaranteed to be ½ of 1% in either direction of rotation. The instrument is adapted for high and very low speeds, and has a ratio up to 1:40. It can be used as a hand tachometer without gear shifts with a handle and driving tip.

Lukens Stainless-Clad Steel Has Higher Heat Conductivity

A line of Stainless-Clad Steels has been announced by Lukens Steel Co., Coatesville, Pa. The product is a light layer of solid stainless steel bonded to a backing plate of carbon or low-alloy steel. It is available in plate gages to over 3 in. thick, up to 162 in. wide and in formed heads of all styles up to 18-in. dia. It is said that the line gives the protection and corrosion resistance of solid stainless steel and has higher heat conductivity.

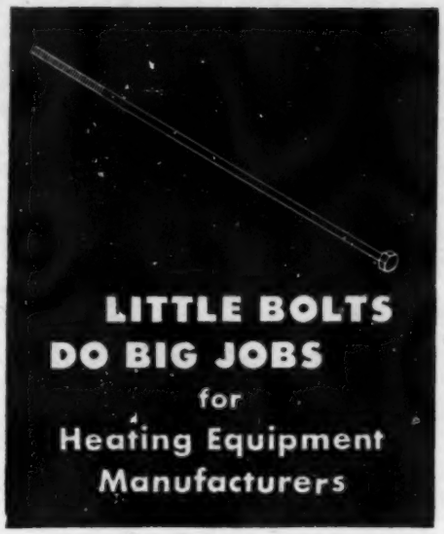


RELIEF VALVE

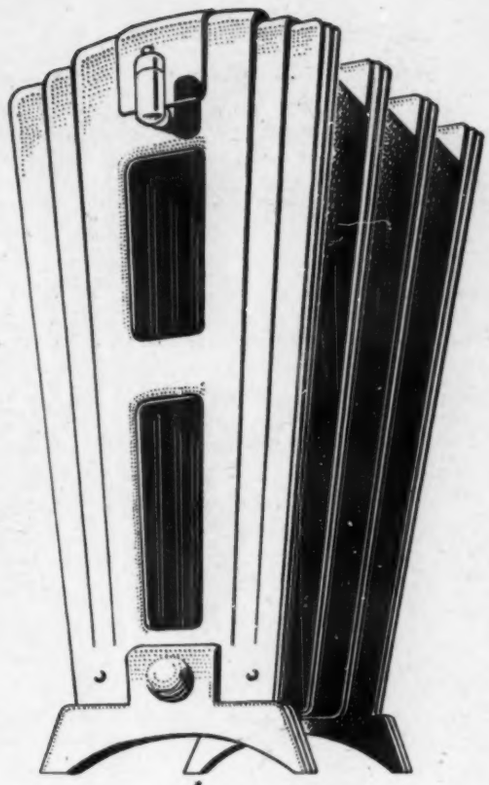
RELIEF VALVE—A 5000 psi. relief valve for high-pressure systems has been developed by Superdraulic Corp., 12835 Ford Rd., Dearborn, Mich. It is said to eliminate squealing and chatter and provide instantaneous action. Provision is made for remote control and accurate maintenance of pressure setting. Hydraulic balance insures high efficiency and long life

West Durma-Gard Plastic Apron Protects Against Acids, Oils

The Durma-Gard Apron is made by West Disinfecting Co., 42-16 West St., Long Island City 1, N. Y. The apron offers protection against acids, alkalis, grease, oils and other agents. Made of plastic, it has heat-sealed seams and reinforced stress points.



LITTLE BOLTS DO BIG JOBS
for
Heating Equipment Manufacturers



DID YOU KNOW *that Buffalo Bolt has its own rolling mill and controls the quality of its products from billet to final threading . . . the latter operation being illustrated above.*

THE development of modern home heating equipment is highlighted by its clean appearance, compact size, high efficiency and fully automatic operation. Not so obvious—though equally important—is the part played by present-day fasteners in the assembly of this equipment . . . fasteners such as the special Circle Ⓑ Bolt illustrated which is used in large volume by leading radiator manufacturers.

Circle Ⓑ Bolts and Nuts are produced to meet the requirements of the most advanced equipment designs. These famous fasteners, standard or special, are noted for their uniform size and strength . . . qualities that keep assembly lines moving with maximum efficiency . . . qualities that contribute to the appearance and durability of the equipment on which they are used.

Ⓑ BUFFALO BOLT COMPANY

NORTH TONAWANDA, N. Y. · SALES OFFICES IN PRINCIPAL CITIES

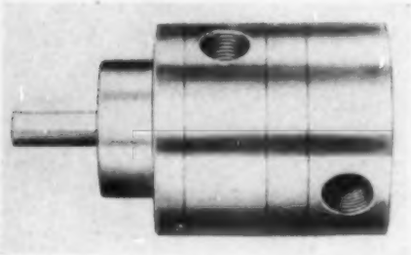
Export Sales Office: Buffalo International Corp., 50 Church Street, New York City

POM Arc-Welding Compound Stabilizes and Quiets Arc

POM, an improved arc-welding compound, is announced by G. W. Smith & Sons, Inc., 5400 Kemp Rd., Dayton 3, Ohio. Developed to produce cleaner and better welds, it is an electrically conductive, inorganic composition to supplement the fluxing action of welding-rod coating.

POM is a paste which is thinned with an equal part of water and brushed or sprayed into the seam and on adjacent surfaces where spatter collects. It is said to stabilize and quiet the arc, prevent breakage, improve fusion, prevent scale and prevent adhesion of weld spatter. It contains no combustible ingredients and thus causes no smoke or fumes. After welding, spatter and POM are wiped off with a cloth.

Ellipse S-125 Rotary Pump Ejects with Vanes and Rotor



The Series S-125 rotary pump is announced by Pump Div., Ellipse Corp., 24 S. Clinton St., Chicago 6, Ill. Designed for applications where small size, low power and high pressure are desirable, the pump ejects by means of vanes and rotor, and not by centrifugal force alone.

At 140 F, using 150-viscosity oil, the S-125 has a 2.5 gpm. capacity, 1000-psi. pressure and 26-in. vacuum. It is non-pulsating because of circular unidirectional flow, can be assembled to run in either direction, and handles a wide variety of fluids.

Airco Stainless-Steel Electrodes Made with Two Types of Coating

A line of Airco stainless-steel electrodes in full range of diameters and grades is made by Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.

All electrodes are furnished with a heavy extruded lime-type coating for dc. application. A lime-titania coating is available for all electrodes, except the straight-chrome analyses, for alternating or direct current.

The lime-titania type electrodes offer features not available with the dc. electrodes. They are said to eliminate arc-blow and result in easier manipulation and more uniform arc action. This class is recommended for all of the applications on which lime-type electrodes are used, except for highly restrained joints on heavy sections or on steels of high hardenability.

CASTER—An aluminum-alloy rubber-tired caster in rigid and swivel types is announced by Aerol Co., 1823 E. Washington Blvd., Los Angeles, Cal. The caster embodies features such as heavy-duty, shake-proof king pin, labyrinth dirt seal, and extra offset for instant trailing. The alloy increases efficiency by cutting down dead weight without sacrificing strength. The caster is available in a complete range of sizes

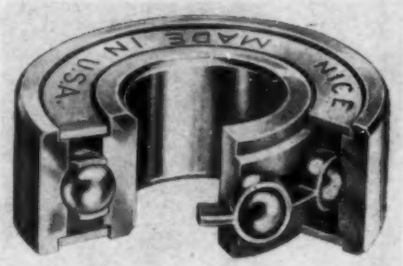
Westinghouse Welding Electrodes For Low-Alloy Cast, Rolled Steel

AP-MO and SW-2 electrodes have been announced by Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

AP-MO electrodes are for dc. reverse-polarity welding of low-alloy cast steel or low-alloy high-tensile-strength rolled steels in all positions. Available in three diameters from ⅛- to 3/16-in., they are designed for butt and fillet welds.

SW-2 electrodes are for ac. or either polarity dc. (straight preferred) welding of mild steel in all positions. Available in four diameters from 3/16-in. to 5/16-in., the electrodes are said to produce welds with desirable flat contours, side-wall wash-up, freedom from undercutting, and easy slag removal.

Nice Unground Radial Bearings Take Medium Loads at 3000 rpm.



The Series 3000 line of unground radial bearings is announced by Nice Ball Bearing Co., Hunting Park Ave., Philadelphia 40, Pa. The units are designed for medium loads and maximum speeds of 2500 to 3000 rpm. Where loads are smaller and service is intermittent, higher speeds can be used.

Ball retainers reduce contact friction and increase speed range. The depth of groove in the ball tracks provides considerable thrust capacity. All bearings are held to 0.005-in. tolerance (or less) on I.D. and ground to 0.0006 in. (or less) on O.D. Bearings can be furnished with or without grease, and double shielded, with one shield or without shield.

G. W. Smith & Sons Lubricant Takes Extremely High Pressure

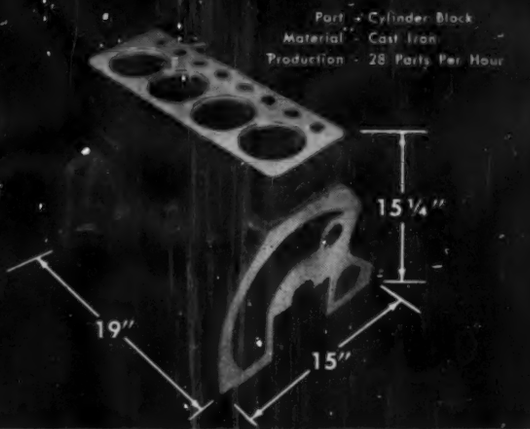
Die Slick No. 5, a metalworking lubricant for either extremely high pressures or high temperatures or both is announced by G. W. Smith & Sons, Inc., 5400 Kemp Rd., Dayton 3, Ohio. It is used on ferrous or nonferrous metals for such applications as hot-drawing, hot-piercing, hot-forging and deep-drawing operations. It is said to withstand pressures of more than 100,000 psi. and temperatures up to 2300 F.

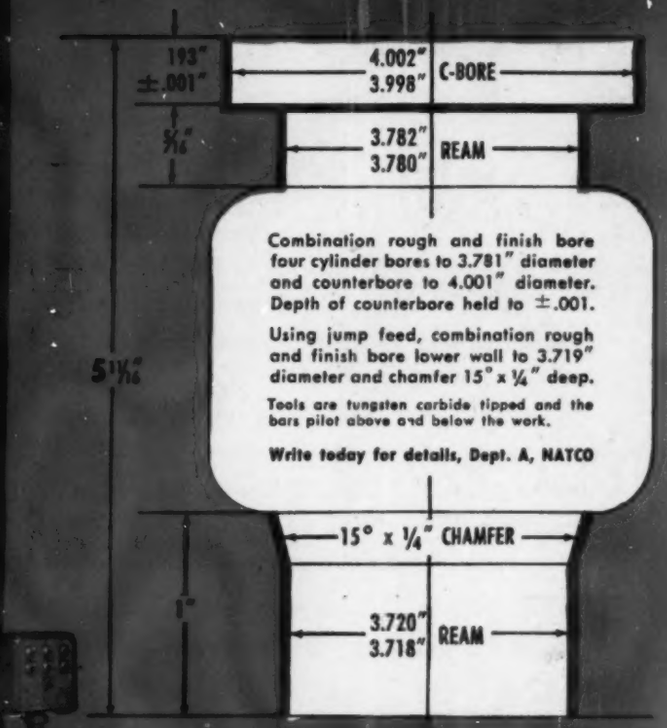
Line of Micro Ball Bearings In Radial and Pivot Designs

A line of Micro ball bearings is announced by New Hampshire Ball Bearings Inc., 11 Main St., Peterborough, N. H. The bearings are available in precision, solid-race, radial and pivot designs. Dimensions are English (5/32 to ⅜-in. O.D.) and metric. Quantity production is said to give advantages of anti-friction performance to small mechanisms at prices comparable to ordinary-size quality bearings.

Cylinder Boring for replaceable sleeve liners

NATCO HOLESTEEL
vertical machine, arranged with hydraulic feed and a fixed center gear driven head containing four spindles





Combination rough and finish bore four cylinder bores to 3.781" diameter and counterbore to 4.001" diameter. Depth of counterbore held to ±.001.

Using jump feed, combination rough and finish bore lower wall to 3.719" diameter and chamfer 15° x ¼" deep.

Tools are tungsten carbide tipped and the bars pilot above and below the work.

Write today for details, Dept. A, NATCO

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Their soft cotton texture is safe to use on any highly polished or sensitive surface. No hard seams, no hidden grit, no over-looked buttons, such as often turn up in make-shift wipers.

Instead, every KEX Industrial Wiping Towel is made for the important wiping purpose to which you will put it. Edges are bound to eliminate catching onto machinery. Surfaces are smooth and free of lint. They absorb up to six times their weight in grease and oil, and give more wipes per pound than cast-off rags or ordinary wipers.

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For complete information, see your classified Telephone Directory for nearest KEX distributor, or write KEX National Service, 295 Fifth Avenue, New York 16, N. Y.

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ROUND TABLE *Discussion*

CAN THE GRAPEVINE BE KILLED?

Not while human nature remains unchanged! There is a streak in most of us which urges us to get in the limelight. In some it is almost non-existent, in others severely disciplined, but in not a few it bulks very large indeed—in fact it becomes a mainspring of existence. It is among these that your persistent and confirmed rumor-mongers are found.

The idea of a sort of public-relations office has its points, but it is not going to kill the spreading of rumors nor is it going to be able to combat false rumors at all times. When Ed says about rumor-mongers that it "makes them feel big-shots in on the know" he has put his finger on a fundamental point.

Don't run away with the idea that this sort of thing is confined to those in manual jobs or the lower grades of industry and commerce generally. It is as widespread through all grades of society as any other human foible. Where and how do cabinet secrets and highly confidential government papers leak out and become public knowledge? Ninety-nine times out of a hundred it is through some big shot who wants to pose as a still bigger shot.

It is in the interests of a firm to take its employees into its confidence and to give them the maximum amount of information about its affairs that can be disclosed without prejudice to its own or other people's interests. If it is a big firm, it may well be a recognized function of someone in the industrial-relations setup to assume the position of an answerer of questions and a contradictor of rumors, and that may do something to reduce their number and virulence, but so long as mankind is made as it is, so long will there be rumors, rumors and rumor-mongers.

K. N. Harris
Harrow, England

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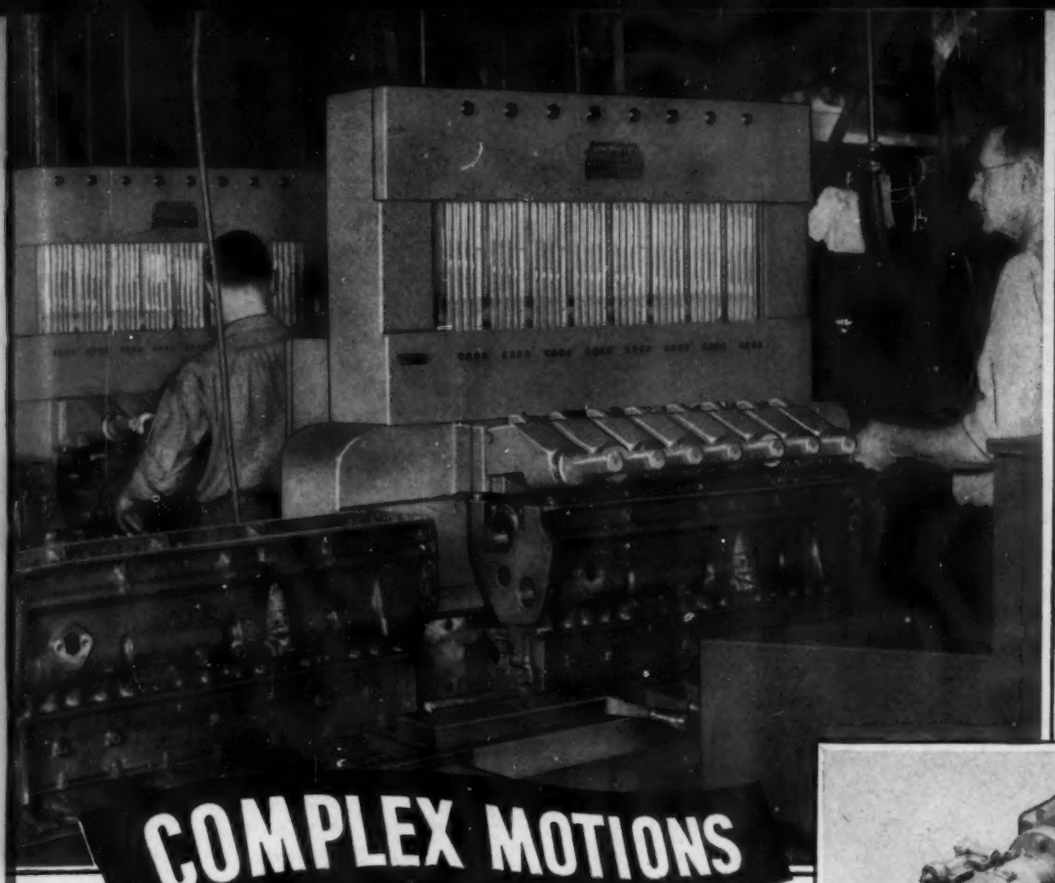
WHY HELP THE DRUMMER?

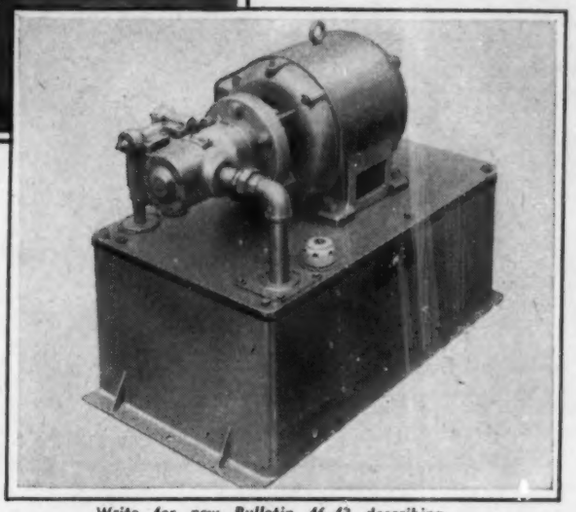
As the jovial, well-dressed salesman peddles his wares among shop men, the minute hand of the well-watched clock moves around twelve times faster than its smaller playmate. From my recent observations, taken



At Left: Sheffield Precisionaire Gaging Machine simultaneously checking 32 points of inspection.

This is one of a series of applications pointing out the many advantages of Vickers Hydraulic Controls.

Below: Vickers Hydraulic Power Unit installed in base of Sheffield Precisionaire Gaging Machine.



COMPLEX MOTIONS

of this AMAZING GAGING MACHINE

MADE SIMPLE BY

VICKERS HYDRAULIC PUMPS AND CONTROLS

Write for new Bulletin 46-A3 describing Vickers Hydraulic Power Units

Sheffield Precisionaire Gaging Machine simultaneously measures the diameter at four points in each of 8 cylinders in a motor block—32 points in all. Each bore is then stamped with its true diameter for selective assembly. At the rate of 50 blocks or more per hour, the savings made by this machine have been spectacular.

The machine must make a complex series of motions on each block: (1) ram pushes block into position, (2) two rams from behind push block against stop for accurate transverse location, (3) plunger from above engages hole for accurate longitudinal location, (4) gaging plungers come up simultaneously—one for each cylinder, and (5) withdraw gaging plungers and locating plunger, then return ram.

One push button puts motions No. 1, 2 and 3 (above) into automatic operation; another push button actuates motion No. 4 while a third actuates motion No. 5. To get them all into limited space with proper sequential timing by any other means would have been a difficult problem for the designer. But Vickers Hydraulic Equipment simplified the job. Hydraulic pressure is supplied by a Vickers Power Unit which consists of motor, tank, pump and relief valve all in one compact assembly ready to connect to the hydraulic circuit.

The Vickers Application Engineer nearest you can undoubtedly show you highly satisfactory hydraulic solutions to machine control problems similar to your own.

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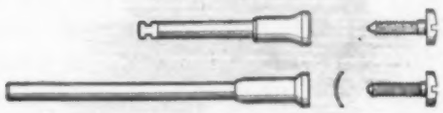
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

New Tools
FOR FAST PRODUCTION

DIAMOND POINTS AND WHEELS
are fast and cool cutting and retain their original shape.



STAINLESS MANDRELS

Precision handpieces are a necessity in every type of production shop and tool room. They are used with burs, drills, reamers, abrasive stones and diamond wheels. They very often replace larger and more expensive machines, and with increased efficiency.

The spindles, for high speed, have a heavy deposit of chromium on the bearing surfaces and are precision ground, reducing wear to a minimum. They provide easy access to small areas.

Pencil size provides precise manipulation and positive control. Light weight reduces employee fatigue.

Engine drives with connections are available as well as a large selection of diamond and abrasive wheels and mounted points. Write for complete information.

MIDWEST
DENTAL MANUFACTURING COMPANY
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in a small manufacturing establishment employing about fifteen men, it seems that the entrance of the loquacious dispenser of fine tools was the awaited signal for time out.

As the innocent production interrupter approached his first client, Bill Smith, Harry Jones glanced up at the clock, wiped his hands carefully with a clean rag, and, whether out of pure curiosity or eagerness to have an elbow session, lost no time in joining the pair. Within five minutes, Mulchaney had shut off his lathe, Fritznickel let his shaper ram become inert, and the skinny little Englishman had joined in for the kill. "What a job for a timesetter!" I said to myself before exercising my own prerogative and sidling up to the rest. Soon there were no less than eight men eagerly examining, very carefully and time-consumingly, the latest in micrometers, depth gages, and whatnots.

By the time the drummer was ready to leave, there was a dark-brown disturbance on the boss' forehead and a considerably changed face on the time clock.

While some inconsiderate employers deserve a little gyping now and then, I cannot see why others, who are fair to their employees, should be suckers and shoulder the expense of the "party" so often relished by the time-killing element.

I am reminded of the time in Chicago when a slick salesman entered the shop in which I worked and convinced my fellow toolmakers and me of the indispensability of his product. What the man was selling was, as he called it, a black-diamond oilstone secured from the great depths below the source of the famous Arkansas white product so familiar to us. He particularly praised it for its unusual effectiveness in honing razors. This occurred in the days when men were men and everyone who wore long trousers used a "straight." I was young and had recently been married and in order to look "tops" I took particular delight in my tonsorial splendor.

Well, with the customary gullibility, I procured one of the prehistoric products and took it home. About two weeks after, one of the men in the shop asked me, casually like, so as not to let his favorite cat out of the bag, "How's your razor feeling these days, Homey?" I, in order to conceal what an easy mark I had been, came back with a white lie and told him that I thought the hone was a good one.

The truth of the matter was that I had used the thing only once, with seeming good result, but, the next

BETTER GRINDING... FASTER GRINDING... WITH STERLING CHUCKS AND SEGMENTS

Sterling No. 2 Chucks and Segments combine solid grinding wheel efficiency with all the cooler-grinding advantages of theoretical clearance. Sterling segments are identical throughout—provide the same high quality grinding after long use as when first started on the job. Adaptable to a wide variety of machines using 8" to 20" cylinder wheels, they have been tested and approved by workers and foremen of grinding departments everywhere.

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"THE WHEELS OF INDUSTRY"
INTERLOCKING DESIGN MEANS ADDED STRENGTH
RETAINING BAND FOR EXTRA STRENGTH
CHUCK MAINTAINS INDIVIDUAL GRIP AS SEGMENT WEARS DOWN
LIGHT WEIGHT CHUCK-EASY ON BEARINGS
CURVED EDGE PROMOTES CONTINUOUS SHEARING ACTION
SPACE BETWEEN SEGMENTS FOR COOLER GRINDING

Speed up your surface grinding by using Sterling segments! They form an abrasive ring that provides grinding efficiency every second they are in operation. Have a Sterling engineer demonstrate them in your plant and see for yourself what they can accomplish.

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One order and one invoice for varied production and maintenance needs makes the nearest Ryerson plant a time-saving source. Eleven other Ryerson plants bring added convenience. When ordering for a distant operation you can deal with a familiar nearby source and have the steel shipped from the plant nearest the point of delivery.

Ryerson metallurgists and engineers, thoroughly familiar with the specialized steel requirements of your industry, will work with you on any problem of selection or application. Call Ryerson for prompt, helpful service on steel.

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RYERSON STEEL

time I tried it out my razor wouldn't purr with its customary satisfaction. Through some stroke of good fortune, the little black-diamond beauty slipped from my grasp and crashed into bits on the tile floor of the bathroom.

It was then that I saw that the ingenious crook, whose high-pressure facial expressions put me out as would a good, wholesome whiff of chloroform, had glued a rectangular piece of frosted, plate glass into a black-painted, shallow box, and, in order to cover up its true nature, painted a gloss black around its four edges. For some reason or other this has been a thorn in my side all these years. One cannot blame me too much for looking upon a salesman, who peddles his goods during working hours, as being an evil waste of valuable company time.

J. Homewood
Ontario, Calif.

•

WHEEDLER OR NEEDLER?

In my experience as a foreman and expediter, I have found neither course is the best to follow as a fixed procedure.

I believe an expediter should coordinate and make more efficient the supply of raw materials to the point of processing; make sure those parts needed first came to assembly first. To do this an expediter should know all details of work that make up the finish job he is expediting. He should not push a job before it is to be used—at least not so the man who worked on it can see it. Remember the boy shepherd who cried "Wolf!" once too often to be believed.

If a man is told what to do first, and if it is an extra-rush job, simply tell the man or his foreman that the expediter would like to have a certain item as soon as possible, and it will usually bring results.

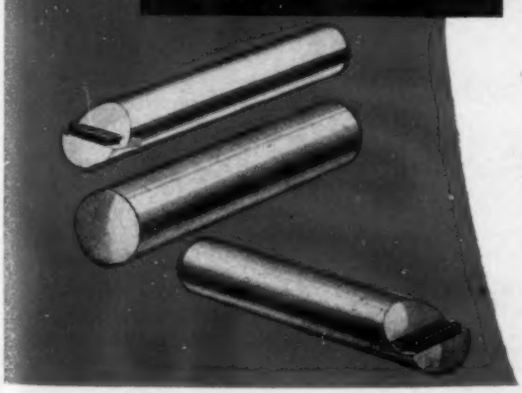
I work on the principle of timing parts, but if I miss something, I ask for a little more speed, and get it. It is also important to let the men see that the expediter is working just as hard to achieve results as they are.

Rather than needling, better results can be gotten by simply saying: "Bill, here is a job that is needed bad on that assembly line. How about pushing these awhile to get a head start?"; or by saying, "Bill, here is a job that is needed bad. Can you rush it, and I will get the order later?"

Albert E. Lyon
Toledo, Ohio

"Standards"
Finish-Ground . . . *ready to go.*

"Universals"
Tipped and Solid Carboloy Blank. You quickly grind to *Desired Shape.*



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With these Standard CARBOLOY boring tools

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★ **FOR PRECISION**

★ **FOR CONVENIENCE**

—put these Carboloy Tools to work on all your small boring jobs. Complete standard line of Carboloy-tipped finish-ground boring tools covers a wide range of standard boring jobs. When special shapes are required, use one of the two "universal" styles—quickly ground to finish shape.

Carboloy-tipped finish-ground boring tools are designed to fit standard boring bars. They are available in both square and round shanks, and in a wide variety of styles and sizes to cover a broad range of applications. Other standards also available for large boring jobs. Stocked for fast delivery coast-to-coast at 70 Carboloy distributors. Call your nearest distributor today. Carboloy Co., Inc., 11149 E. Eight Mile Street, Detroit 32, Mich.

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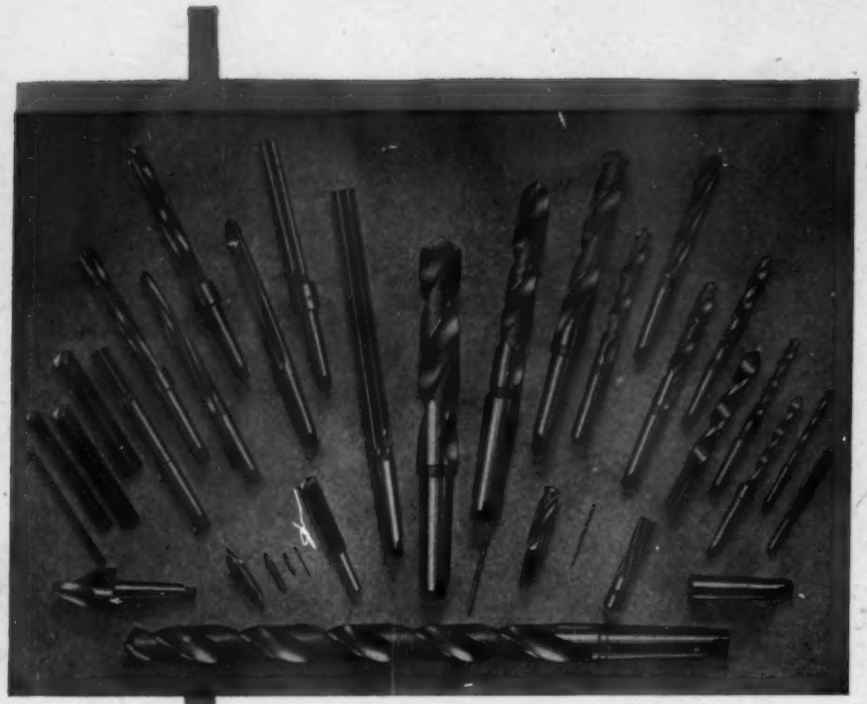

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PRODUCTION CONTROL IN AN ENGINEERING FACTORY—*By M. L. Yates. 36 pages. Price 2s.* Nomograph (25) describes production control methods found serviceable in certain factories, manufacturing partly for stock and partly for customers' orders a range of products, each of which is made up of a relatively large number of individual parts. Features covered are materials lists, stock-control arrangements, and a tag system of production control. A tag consists of all operation tickets relating to one batch of similar parts and bound between durable covers.

TIME STUDY IN LIGHT INDUSTRY—*By S. Bloye Dipple. 65 pages. Price 2s. 6d.* Nomograph (27) presents clearly the principles and techniques of time study with reference to both English and American practices. It discusses measurement of time elements and performance, fatigue allowances, adjustment for factory limitations, standard times and synthetic setups, standard times for press, drilling and assembly operations and the application of incentive methods to inspection.

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PERSONNEL SERIES BULLETINS—*Published by the American Management Association, 330 West 42nd St., New York 18, N. Y., from papers presented at the 1946 personnel conference.*

Bulletin 97 (47 pages—$0.75) covers new concepts in collective bargaining in the following papers: Labor Relations Today—Frank Rising; Fact Finding and Ability to

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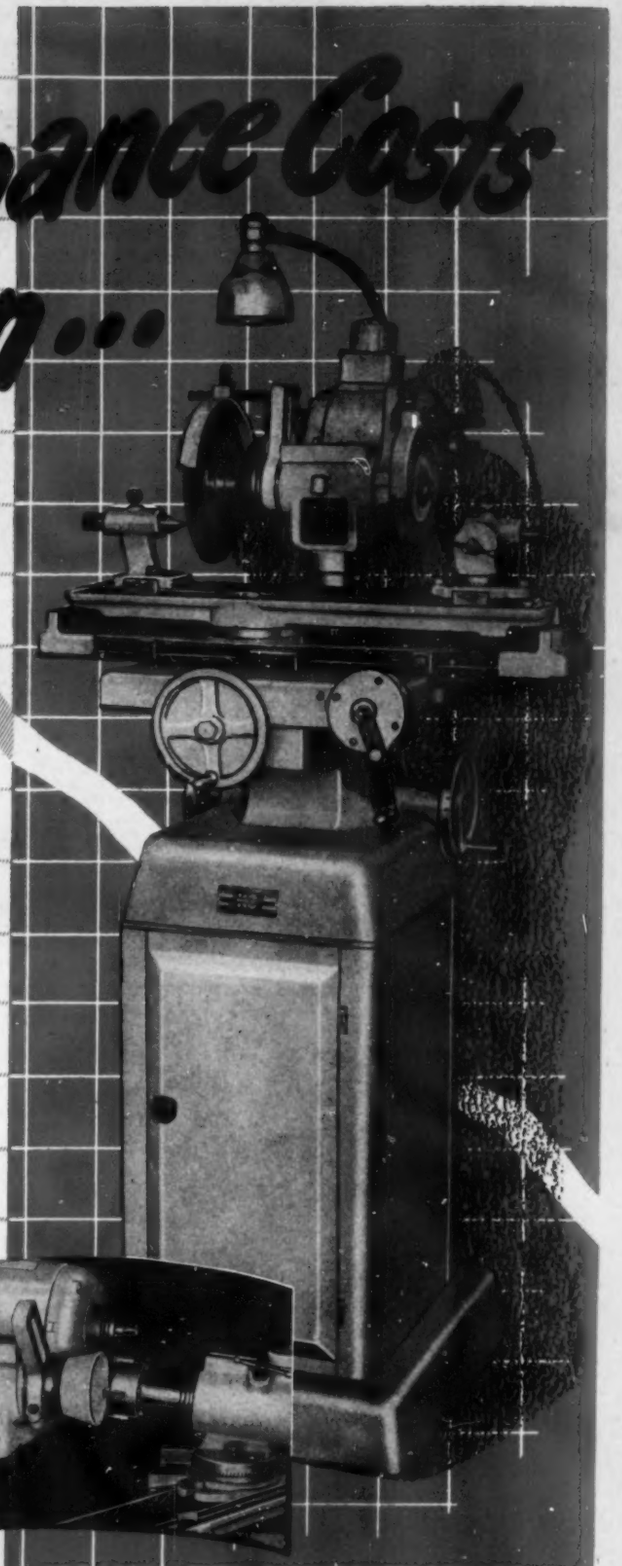
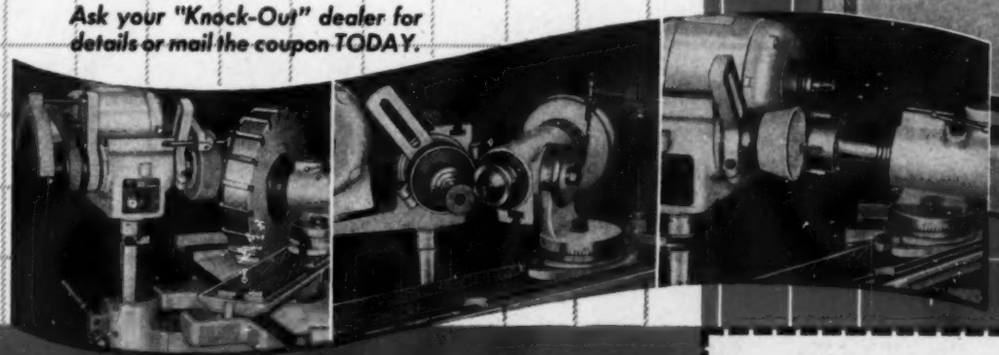


Tool Maintenance Costs Come Down when you use a "Knock-Out" Universal Cutter Grinder.

Set-ups are simpler, easier to make—less time is lost between jobs—more tools of all types can be properly reconditioned at less cost with a "Knock-Out" Universal Cutter Grinder. Handles internal, external and surface grinding too. A "Knock-Out" Universal Cutter Grinder is the busiest machine in *any* Tool Room.

Ask your "Knock-Out" dealer for details or mail the coupon TODAY.



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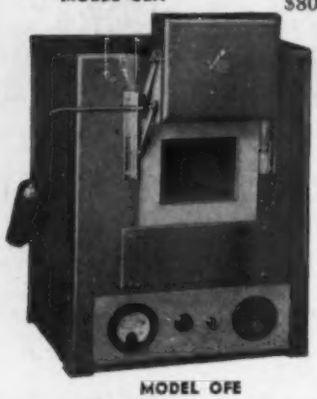
Model CEA is designed to give outstanding performance at low initial and operating costs. Has special high temperature heating element embedded in four sides of muffle lining for protection and uniform heating. Built with TEMCO stepless control which permits operator to select and hold any temperature from 500° to 2000° F. Maintains even temperature regardless of normal changes in line voltage. Heating chamber 4¾"x4¼"x6". Max. input 1.5 kwh. Insulated cast-aluminum body. Supplied with attachment cord ready to plug in and operate. For 115 V. AC $80.00; 230 V. AC $85.00. *Also available for DC.*



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Model OFE is built for continuous use up to 1600° F, intermittent to 1900° F. Synchronous motor driven input controller permits selection and holding of any temperature from 250° F to maximum. Highest quality nickel-chromium alloy heating element covers four sides of chamber. Steel frame with 4½" insulation. Counterbalanced door opens upward. Muffle chamber 6"x5"x10". Maximum power consumption 2.2 kwh. For 115 or 230 V. AC $194.00.

Models CEA and OFE are equipped with an indicating pyrometer calibrated in both F. and C. scales. They are economical to operate as nearly all the power is consumed within the heating chamber. Ideal for general laboratory uses, heat treating and small unit production.

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- DURABLE
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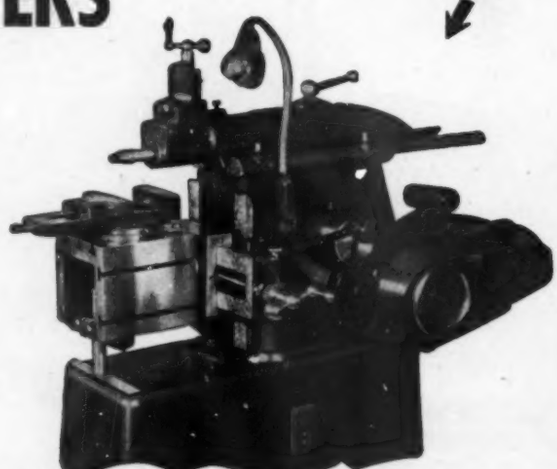

You can depend upon the built-in accuracy and durability of Shape-Rite Shapers to withstand day-in and day-out capacity production. The speedy set up features and ease of operation will increase the output of precision work. Shape-Rite Shapers are Versatile, and will handle any type of work within the capacity of eight-inch stroke Shapers. Unexcelled for Tool and Die Makers and small instrument manufacturers. Complete specifications on request. *Write to Dept. A-9.*

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Pay—Clarence B. Randall; Salient Characteristics of Postwar Union Agreements—Ralph A. Lind; and Implications of Company Security against Stoppages—Samuel Schuchter.

Bulletin 98 (32 pages—$0.75) on reconciling labor and management philosophies includes: The Common Goal of Management and Labor—George D. Heaton; Labor and Management Look Ahead—E. Wright Bakke; and Labor, Management and Congress—Robert Ramspeck.

Bulletin 99 (42 pages—$0.75) covers constructive employee relations in unionized and non-unionized plants in: Labor Relations in a Non-Unionized Company—Raymond S. Livingstone; Areas for Labor and Management Cooperation—a panel discussion by George Hodge, Guy B. Arthur, Larry A. Coombs, William Gomberg and Joseph Scanlon; and Employee and Public Relations—Eugene J. Lyons.

Bulletin 100 (43 pages—$0.75) on rating and training executives and employees includes papers: Employee Selection for the Average Company—Richard A. Fear; Merit Rating: Its Validity and Techniques—Joseph Tiffen; Executive Development Program for Affiliates of Standard Oil Co. (N.J.)—George B. Corless; and Interpretation of Personnel Reports and Statistics—Dale Yoder.

Scanning the wide list of subjects covered shows clearly the range of interesting and informative ideas presented. Whether or not one agrees with all ideas, beliefs and suggestions in the papers, there can be no disagreement with the effort of A.M.A. to promote clear, concise thinking on these subjects and action to better personnel methods and objectives. Bulletins are recommended highly to all executives.

•

EXAMINATION OF INDUSTRIAL MEASUREMENTS—*By John W. Dudley, Jr., Chemical Engineer, American Viscose Co. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y. 113 pages. Price $2.00.*

Covering the fundamentals of statistical techniques for detection of variation in the manufacture of industrial products, this book does not confine its treatment to its titled subject.

It is rather a discussion on statistical theory, quality-control charts, quartile analyses, correlation and curve fitting. Written to acquaint engineers with statistical tools, it can

well serve its purpose, even though, or possibly because, mathematics have been kept to a minimum. For those who wish to inquire into the detailed mathematical background of the statistical theories, a bibliography is given.

Throughout the book are examples that demonstrate the examination of various types of industrial measurements and illustrate how reliable data can be distinguished from erratic data.

•

HOW TO SUPERVISE PEOPLE IN INDUSTRY—*By Dr. Eliot D. Chapple, Pres., The Chapple Co., and Edmond F. Wright, Asst. Dean, Graduate School of Business Administration, Harvard University. Published by National Foremen's Institute, Inc., Deep River, Conn. 123 pages. Price $2.50.*

Application of human-relations principles in dealing with workers may be considered one of the most important, if not the most important, factor in increasing of worker productivity and improving the production on which rests the survival of a manufacturing organization.

The authors have directed this book to that purpose—to show foremen how to be foremen. The job of being a foreman is delineated in all its vital functions. In addition to general human-relations' aspects, specific problems as discipline, training new employees, keeping of adequate records, interviewing job applicants, relationship with top management and living with union representatives are treated fully and adequately.

•

A BIBLIOGRAPHY ON DIE CASTING—*By the Editors of Die Castings magazine. Published by The Technical Publishing Co., 1240 Ontario St., Cleveland 13, Ohio. Price $7.50.*

Technological development in recent years has expanded the scope of die casting as a method of metal fabrication. For the first time, a bound bibliography on this subject is offered to product designers, research men, metallurgists, technical librarians and production engineers. There are over 1,200 references covering the American, English, French and German literature from 1915 through 1946. The volume is broken down into 8 separate subject-matter headings such as alloys, applications and uses, design, finishing, general data, machines, process and properties.

Tool Expense is Excessive with Antiquated Checking Systems

Change to McCaskey Tool Control and you will save in a dozen ways—save tools and the time of both employees and machines.

The East Plant Motor Div., General Electric Co., Pittsfield, Mass., for example, reduced tool requirements and loss thru McCaskey Control. Mr. Charles W. Reagan, Tools & Methods Dept., told in a recent issue of Factory Management and Maintenance how these dollar-saving results were gained over a three year period:

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Whether you have one or several cribs for production or maintenance work, McCaskey Control will cut your tool costs and prevent production delays. Write for a reprint of Mr. Reagan's article, "Flexible Tool Control Repays Costs Many Times Over," and similar reports of cost-reduction and improved operations in other well-known plants.

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To help you find solutions to problems in any of these fields, Sun Oil Company offers a wide selection of "Job Proved" petroleum products, plus the experience of Sun Engineers. Their know-how and detailed product information are yours for the asking, without obligation. Telephone your local Sun office, or write Dept. AM-4.

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SUNVIS OILS — Are in the same category as Solnus Oils with the difference that, in addition, they meet practically all paraffinic and high V.I. oil specifications.

OCNUS OILS — Low carbon-content oils, containing an additive which minimizes oxidation and gives detergency. Ideal lubricants for internal combustion engines subjected to continuous heavy loads under the most adverse operating conditions.

DYNAVIS OILS — Low pour point inhibited oils which help prevent formation of harmful corrosive and sludge-forming acids. Well-suited for engines fitted with alloy bearings and operated at high temperatures.

SUNTAC OILS — 100% petroleum products which have been treated to increase their adhesiveness. Recommended for general lubrication in all industries where sudden shocks and reversal of loads take place. These oils cling to the parts to be lubricated.

CIRCO OILS — Used for general lubrication of industrial machinery when straight mineral oils are required.

SUNISO REFRIGERATION OILS — Have extremely low pour points and long life stability characteristics. Initially neutral and resistant to formation of detrimental acids under service conditions. The most outstanding oils in the refrigerating and air-conditioning fields.

STEAM CYLINDER OILS — High flash and fire point lubricants for either saturated or superheated steam conditions and for worm gear speed reduction units.

SUN CAR JOURNAL OILS — Dark oils meeting A.A.R. Specifications. For use on railroad cars and waste-packed bearings of railroad equipment.

SUN DELAWARE OILS — Dark oils for general lubrication on older type industrial machinery.

SUNOCO WAY LUBRICANT — Has good metal-wetting and adhesive properties, ample viscosity and E.P. qualities. For use on tableways, as it eliminates chatter and scoring . . . resists corrosion.

SUN MARINE ENGINE OILS — Compounded with special emulsifying agents in order to provide adhesion to and lubrication of working parts in the presence of water. For the lubrication of bearings, eccentrics, cross-heads and various other parts of steam engines.

ROCK DRILL OIL — Heavy-duty adhesive type oil. For use in jack-hammers, stopers and drifters on heavy-duty mining operations.

SUNVIS 900 SERIES TURBINE OILS — High V.I., predominantly paraffinic oils, of uniform 0°F. pour points, containing additives to give high oxidation stability and corrosion resistance under practical operating conditions. Modern oils for turbine and hydraulic systems.

SUN INDUSTRIAL GREASES

SUN CUP GREASES — Water resistant. For grease cup and grease gun application when the service is not severe.

SUN GUN GREASES — Smooth greases made with medium viscosity oil. Stable under pressure in power guns or booster guns.

ADHESIVE PRESSURE GREASES — Won't drip or splash and are excellent lubricants for open gear applications.

SUN DARK PRESSURE-SYSTEM GREASES — For power-driven central grease lubricating systems in heavy industries. Can also be used as a "medium cup grease."

SUN MINE CAR GREASES — Available in several grades. Suitable for both anti-friction bearings and plain bearing cavity-type wheels.

SUN ROLLER BEARING GREASES — For use on electric motors and generators and other high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS — Black adhesive open gear compounds and wire cable greases. Recommended for open gears on metalworking power presses, mining machinery, old reduction mills, crushers, pump gears, etc.

SUN MINING MACHINE LUBRICANT — Semi-fluid. For use where a light but adhesive type grease is required. Free from separation or decomposition.

SUNOCO TRACTOR ROLLER COMPOUND — For miscellaneous parts of caterpillar or crawler-type tracks. Provides good lubrication with exceptional sealing qualities.

SUN METALWORKING OILS

SUNICUT — Straight or non-emulsifiable transparent cutting oils. Recommended for automatic screw machines and for heavy-duty machining operations.

SUN INDUSTRIAL

JOB PROVED

SUNOCO EMULSIFYING CUTTING OIL—A self-emulsifying oil which produces a stable white emulsion when mixed with water. Sunoco is an efficient and economical cooling and lubricating medium for turning, milling, drilling, and other metalworking operations on both ferrous and non-ferrous metals. It is also an excellent grinding coolant.

SUN QUENCHING OILS—Specially refined oils designed to develop maximum physical properties in a wide variety of steels.

SUN TEMPERING OILS—Specially refined oils for tempering steel up to 550°F. Due to their low carbon content and stability under heat, these oils have an unusually long service life.

SUN ROLLING OILS—Straight and emulsifying oils which will permit maximum production in rolling steel, aluminum and brass.

SUN ANTI-RUST COMPOUNDS—Petroleum base oils with chemical additives designed to prevent the rusting and corrosion of steel.

SUN PROCESSING OILS

SUNOTEX TEXTILE OILS—Designed to impart certain additional properties to various forms of fibers during their processing from the fiber state into a manufactured product. All Sunotex textile oils are emulsifiable in water.

SUN COTTON CONDITIONING OILS—Pale mineral oils which condition the cotton. They prevent waste by cutting down excessive amounts of "fly" or fine air-borne particles of lint.

SUN ASBESTOS FIBER CONDITIONING OIL—Used for spraying on the asbestos during processing. Fibers are not so readily damaged or broken down into harmful dust when this product is used.

SUN CORDAGE OILS—Are adaptable in various formulae used by cordage manufacturers. They are selected products which are highly compatible with additives.

CIRCOSOL—2XH (Rubber Processing)—An elasticator and processing aid for GR-S particularly.

CIRCO LIGHT PROCESS OIL (Rubber Processing)—A processing aid and excellent softener for natural rubber, natural rubber reclaims, and neoprene synthetic rubber particularly. Used for GR-S to some extent.

SUNDEX 53 (Rubber Processing)—An inexpensive product suitable for processing GR-S and blends of GR-S and natural rubber. An established outstanding processing aid for footwear rubber stocks.

CIRCOMAR-5AA (Rubber Processing)—A black colored product used in reclaiming natural rubber scrap. Used also as substitute for asphalt fluxes in processing natural and GR-S rubber. Free-flowing at room temperature.

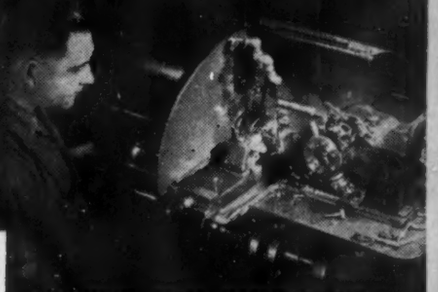
SUN LEATHER OILS—Mineral base leather oils. Used for obtaining the desired tensile strength, proper temper and a controlled moisture content. They maintain a light even color . . . mix well . . . distribute evenly.

SUN MISCELLANEOUS INDUSTRIAL PRODUCTS

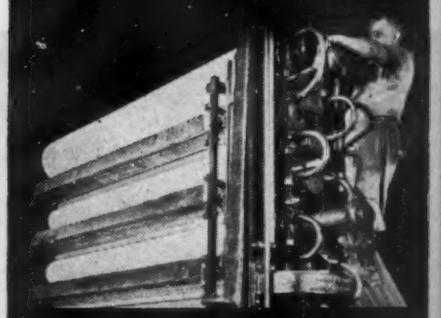
SUN SPIRITS—For the thinning of paints, varnishes, and enamels. Also for metal cleaning. This product is a pure water-white petroleum solvent and is free of corrosive sulphur.

SUN WAXES—Used in packaging, sealing, coating, waterproofing and for numerous manufacturing and chemical processes.

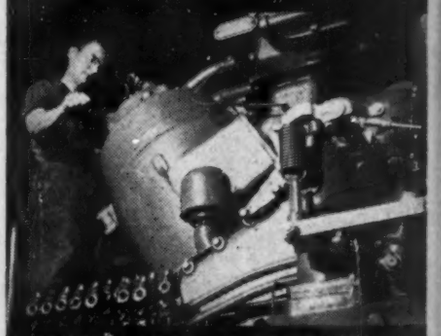
RUBBER MANUFACTURER saved $3,000 a year with a Sun Processing Aid.



ALUMINUM PARTS MANUFACTURER increased output 43% with Sun Cutting Oil.



PAPER MILL slashed annual lubrication bill $2,874 by using a Sun Grease.



POWER PLANT found Sun Diesel Lubricant lasted 50% longer.

A TEXTILE MILL increased slashing speed 60% by adopting a Sun Processing Oil

PRODUCTS

SUNOCO

DRILL HIGHLY ABRASIVE MATERIALS WITH SOLID CARBIDE TWIST DRILLS—

You'll Find Type "C" Ace Drills More Efficient

Only through Ace Drill Corporation's unique "ground from the solid" process is the solid carbide twist drill possible.

Ace TYPE "C" Drills are solid carbide and are constructed with a heavy web and fast spiral, polished flutes to assure you peak efficiency when drilling abrasive non-ferrous metals and plastics.

The economy of using solid carbide twist drills is evident in the continuous production possible with these harder, more wear-resistant drills.

Ace produces Hi-Brinell drills for drilling hardened steel and spiral fluted drills with spiral fluted carbide tips for abrasive non-ferrous material. 2393

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ACE DRILL CORPORATION

MANUFACTURERS OF GROUND-FROM-THE-SOLID DRILLS AND REAMERS

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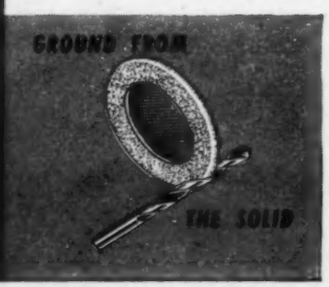
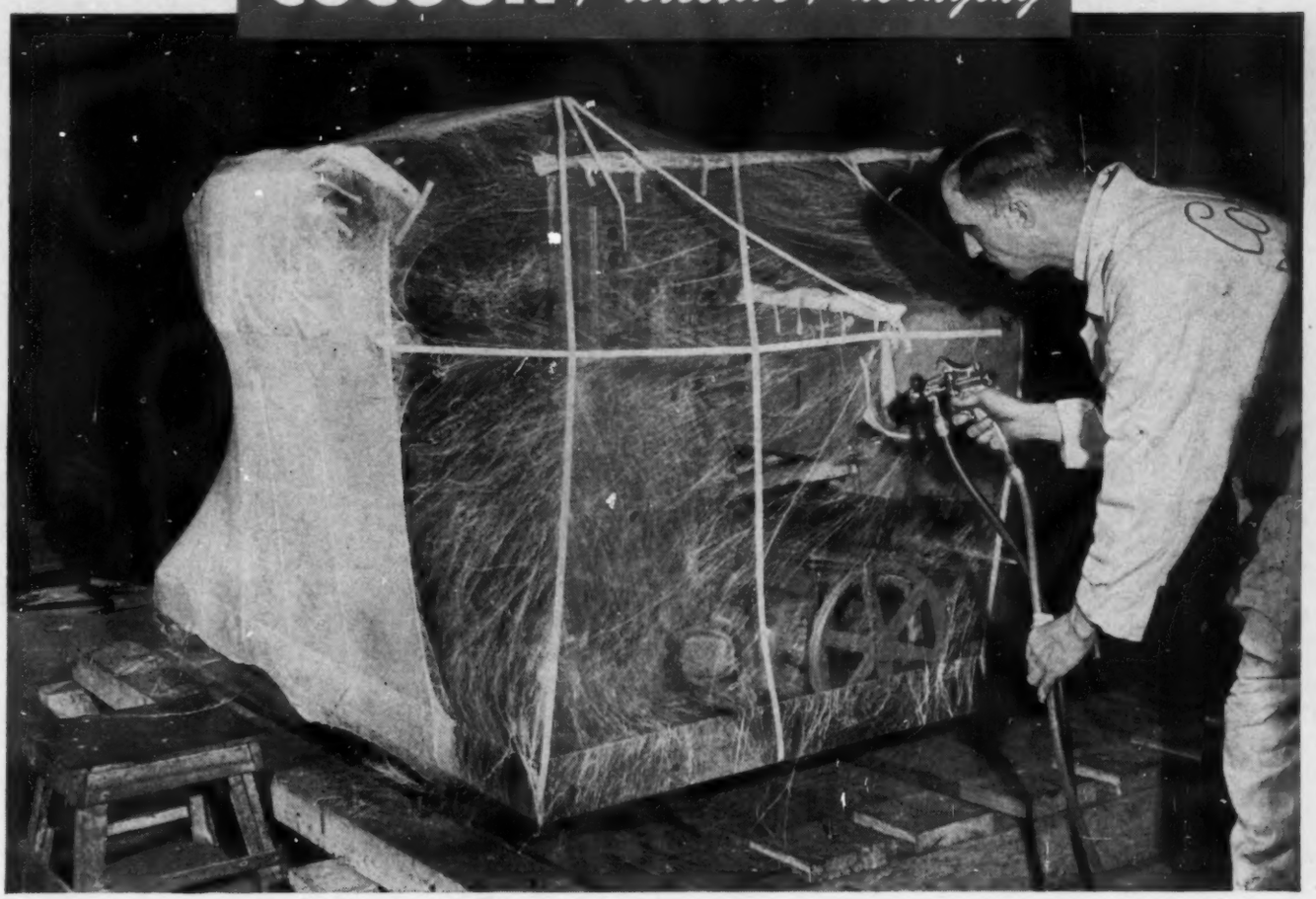


Eliminate unnecessary packing and shipping costs with

COCOON *Protective Packaging*



Now, you can **eliminate** costs like these from your budget: the cost of disassembling machinery and equipment in preparation for packaging . . . the cost of applying greasy preservative coatings . . . the cost of replacing, or re-conditioning, shipments damaged by moisture . . . the cost of removing preservatives and reassembling equipment at destination. These items represent real money!

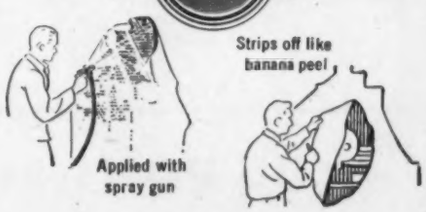
COCOON, the amazing protective packaging applied with a spray gun, affords perfect protection against snow, rain, sun . . . keeps safe *anywhere* anything from a ball bearing to a locomotive. Submit your protective packaging problem to us for analysis. COCOON protection can assure perfect shipment or storage for *your* equipment *anywhere in the world. R. M. Hollingshead Corporation, Camden, New Jersey; Toronto, Canada.*

Package with Cocoon

IMPORTANT

The number and scope of inquiries about COCOON is amazing. To help us answer *your* inquiry quickly—to make it possible to give you a comprehensive recommendation—please give us as many details as possible, including: the item to be packaged; range of sizes; extent of protection required, and for how long; whether your problem involves storage, domestic or export shipment. Descriptive literature or photographs of your product are very helpful.

Whiz



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LEADER IN MAINTENANCE CHEMICALS

How Du Pont's improved solvents tackle your degreasing problems

UNDER VARIOUS TRADE NAMES, Du Pont Trichlorethylene and Perchlorethylene solvents for metal cleaning have served American industry successfully for many years. If you have used vapor degreasing solvents in your plant, no doubt you have used these solvents made by Du Pont.

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LOOK TO the service offered by Du Pont and by distributors of Du Pont solvents to help you conserve your solvents through effective and economic operation. Send *today* for your copy of "Metal Degreasing—Standard Practice." E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Del.

DU PONT SOLVENTS for VAPOR DEGREASING

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

SOLD NATIONALLY THROUGH DISTRIBUTORS

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"TOPS"

in the Rotary File Field

THEY'RE "TOPS" in every respect . . . quality . . . performance . . . . long service. That's why Nicholson Rotary Files and Burs are largely preferred by experienced industrial craftsmen. For throughout their wide range of types, cuts and sizes, Nicholson Rotaries are manufactured to high precision standards — perfectly rounded, true centered, accurately cut or ground, expertly hardened.

For delicate filing operations, Nicholson now offers Rotary Files (hand cut) and Burs (ground from solid) with 1/8" shanks. Available in 9 standard shapes, one degree of coarseness, with stock diameters from 1/8" to 5/8".

For general-purpose filing, there are 1/4" shank Nicholson Hand Cut Rotary Files and Ground Burs. 16 standard shapes. 3 cuts — Coarse, Medium, Fine. 1/8" to 1 1/8" stock diameters.

For long production runs, there are Nicholson Cemented Carbide Burs — with wearing qualities up to a hundred times that of high-speed tool steel. 1/4" shanks. 9 standard shapes. 1/4" to 1" stock diameters.

Write for further information. Also consult your industrial distributor. He will fill your needs and render helpful assistance on selections.

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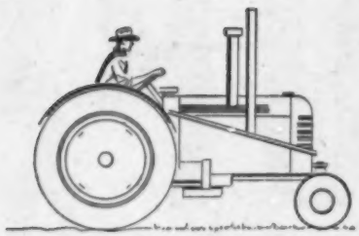
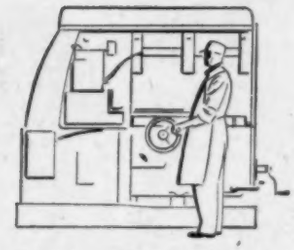
NICHOLSON ROTARY FILES
HAND CUT OR GROUND — FOR EVERY PURPOSE

NICHOLSON U.S.A.



From Farm Machinery



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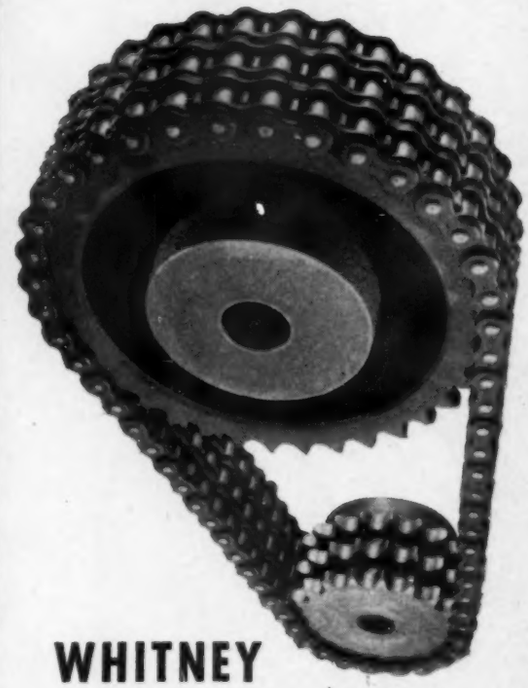
Chain Drive IS BETTER

- *ADAPTABLE TO ALL DESIGN PROBLEMS*
- *POSITIVE GRIP ASSURES EFFICIENT POWER TRANSMISSION*
- *LONG OPERATING LIFE WITH MINIMUM MAINTENANCE*

Whether it's stationary or portable equipment . . . textile or agricultural machinery . . . chain power drive gives highest transmission efficiency. The positive grip eliminates power loss due to slippage and frictional contacts. Because chain drive transmits constant motor speed, it helps maintain product uniformity, cuts down rejections. Its flexibility and adaptability simplify design problems . . . provide a wide range of selection to every application. Chain drive is easy to install, easy to remove without disconnecting shafts . . . has high shock load capacity . . . does not require frequent adjustments to maintain tension . . . gives long-lived performance with little maintenance.

Investigate chain drive for your designs. Whitney Engineers will gladly help you with your problems. Write:



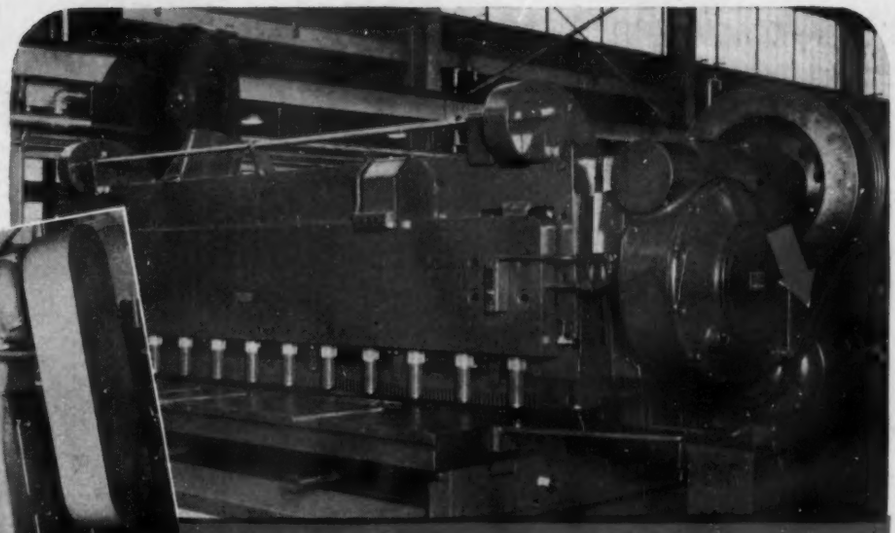
WHITNEY ROLLER CHAINS

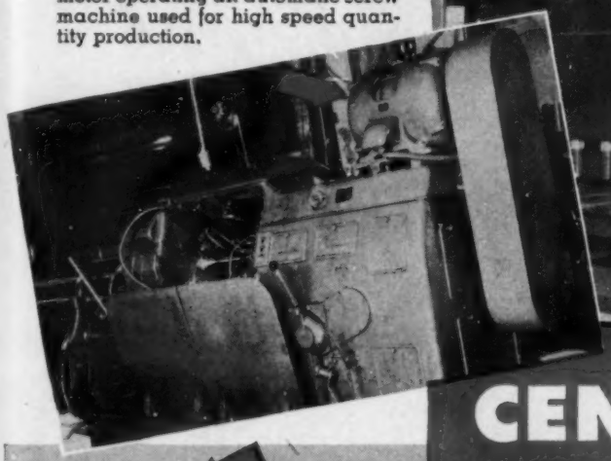
These chains deliver constant, full power smoothly and efficiently. They stand up under the severest operating conditions. All parts are made of alloy steel, hardened to give maximum service with minimum wear. Whitney Roller Chains are available in many types in pitches from ⅜" to 2½". Write for complete specifications.

The Whitney Chain & Mfg. Company, Hartford 2, Connecticut

At right — Century 30 Horse Power high torque, high slip motor operating a heavy duty shear. High slip motor reduces the shock loads when shearing heavy plate.

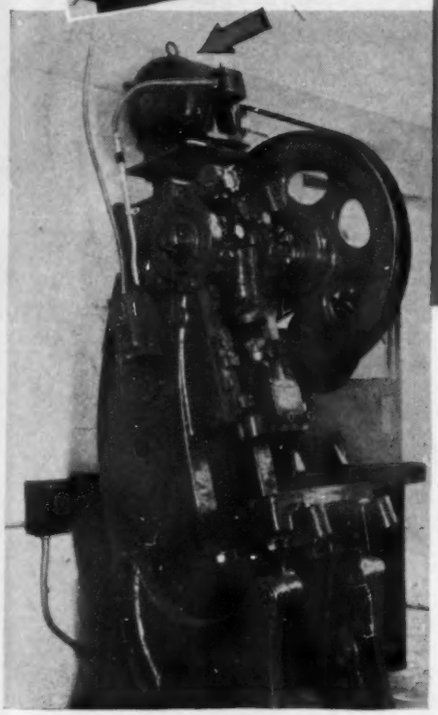
Below — Century 20 Horse Power motor operating an automatic screw machine used for high speed quantity production.





CENTURY MOTORS

Assist in maintaining close tolerance in production...



Century 2 Horse Power, open-rated general purpose motor operating a punch press making small parts.

Thousands of Century motors on machine tools in modern feeder departments are helping to maintain production schedules and keep assembly lines running. The unusual freedom from vibration of these motors assists in maintaining close tolerance in production.

Century machine tool motors are built to stand up under the toughest operating conditions. Their rugged frames, accurately machined feet, large shafts, accurate alignments, good mechanical and electrical balance — all contribute to their outstanding performance.

Century builds a complete line of electric motors and generators, fractional and integral horse power, in the popular sizes to meet the requirements of industrial production, processing, and appliance needs.

Specify Century motors on all electrically powered equipment.

Century C MOTORS

CENTURY ELECTRIC CO.

1806 Pine St. St. Louis 3, Mo.

Offices and Stock Points in Principal Cities

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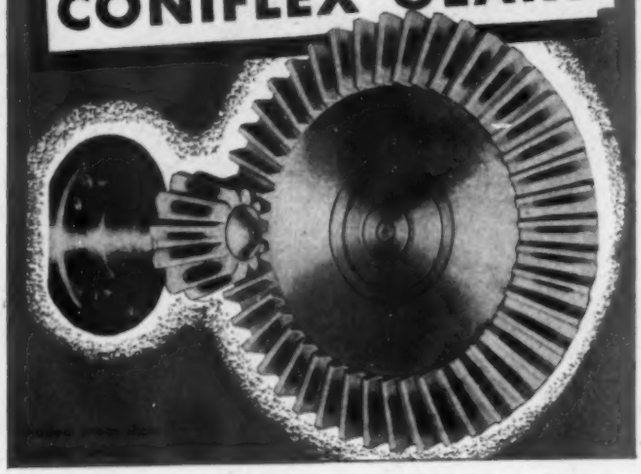
NOW! Sier-Bath makes CONIFLEX GEARS



For greater design freedom... Faster assembly... Reduced wear

SIER-BATH recently installed a Gleason Gear Generator to make Coniflex Gears (straight bevel gears with localized tooth bearing) available to its customers. This feature permits small displacements of the gears under operating loads without concentration of the load on the ends of the teeth. It also saves assembly time by allowing a tolerance in mounting the gears.

In generating Coniflex Gears the tool cuts slightly deeper in the ends of the teeth than at the center. This makes the gear tooth slightly crowned at the center—localizing tooth contact at that point.

Precision machinery plus engineering "know-how" at Sier-Bath can solve your gear problems. Write for information now.

GEAR RANGE:

• Spur, helical and worm gears to 48" Dia. 3 D.P. and finer; straight tooth bevel gears 32 pitch to 3 pitch, up to 23" P.D. depending on ratio. Gears shaved from 1" to 24". Continuous Tooth Herringbone Gears generated by Sykes Method up to 37" O.D. Worms and threads precision ground on J. & L. Thread Grinder to extremely close tolerances. Spur gear grinding up to 16" diameter. Helical gear grinding up to 10" diameter. Involute and straight side splines up to 42" between centers.

ALSO MAKERS OF SIER-BATH SCREW AND GEAREX ROTARY PUMPS

Sier-Bath
GEAR and PUMP CO., Inc.

YOUR REQUIREMENTS
assured by
Our 69-Year Experience

Grant "know-how" in making and supplying gears is at your service. Whether you require a single "special" or stock gears in quantity, it will be to your advantage to submit your requirements to "Grant" for quotation and delivery date. We are in position to render prompt service.

GRANT GEAR WORKS
BOSTON, MASS.

THERE'S MORE TO THIS THAN MEETS THE EYE...IT'S

Performance

To provide the maximum in gear efficiency, CINCINNATI GEARS, where needed, are ground, lapped or shaved. We can shave from 1" to 24" pitch diameter.

In thousands of applications, Cincinnati GEARS, GOOD GEARS ONLY, are proving their unique fitness in meeting engineering demands for precision and performance.

THE CINCINNATI GEAR COMPANY
"Gears... Good Gears Only"
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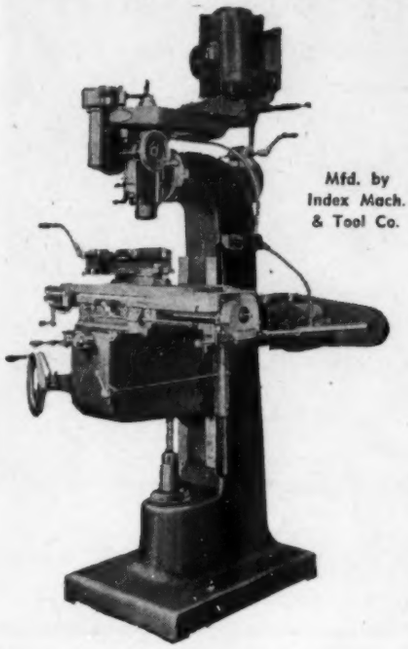
INDEX MILLS

will help you on your tool, die and production work. In addition to micrometer dials on screws, verniers are standard equipment for cross and longitudinal locating. If finer precision is desired, rods and indicators are available. These in conjunction with power feed to a precision ball bearing spindle make a very versatile machine for milling, drilling and boring. *Literature promptly mailed on request.*



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12" Tool Room Rotary Table

A quality tool for precision work in the tool room or production line, incorporating such features as ball bearings—hardened and ground worm—quick acting throw-out for free hand turning—single movement table lock that does not cramp table out of alignment—compound trough. 12" size only.

For use on Index Mills or any other machine that will accommodate a 12" table.

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Precision Gears in Production Quantities

We specialize in the mass production of precision gears to customers' specifications.

We have the necessary facilities and skill to produce such gears in all materials in any quantity, and to meet any specifications that modern machine tools under the supervision of New England craftsmen can turn out.

You furnish the specifications—we'll produce the gears

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PERKINS MAKES: Helical Gears, Bevel Gears, Ratchets, Worm Gears, Spiral Gears, Spur Gears, Ground Thread Worms

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Sandblasting
IS ECONOMICAL IF THE NOZZLE
LIVES 1,500 HOURS *this one does*

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PISTON RINGS
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MADE OF HIGH QUALITY ALLOY STEEL
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Designed and manufactured by the builders of Chambersburg Hammers.

a. Retain their spring and size
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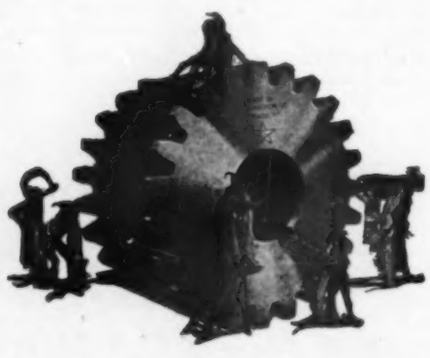

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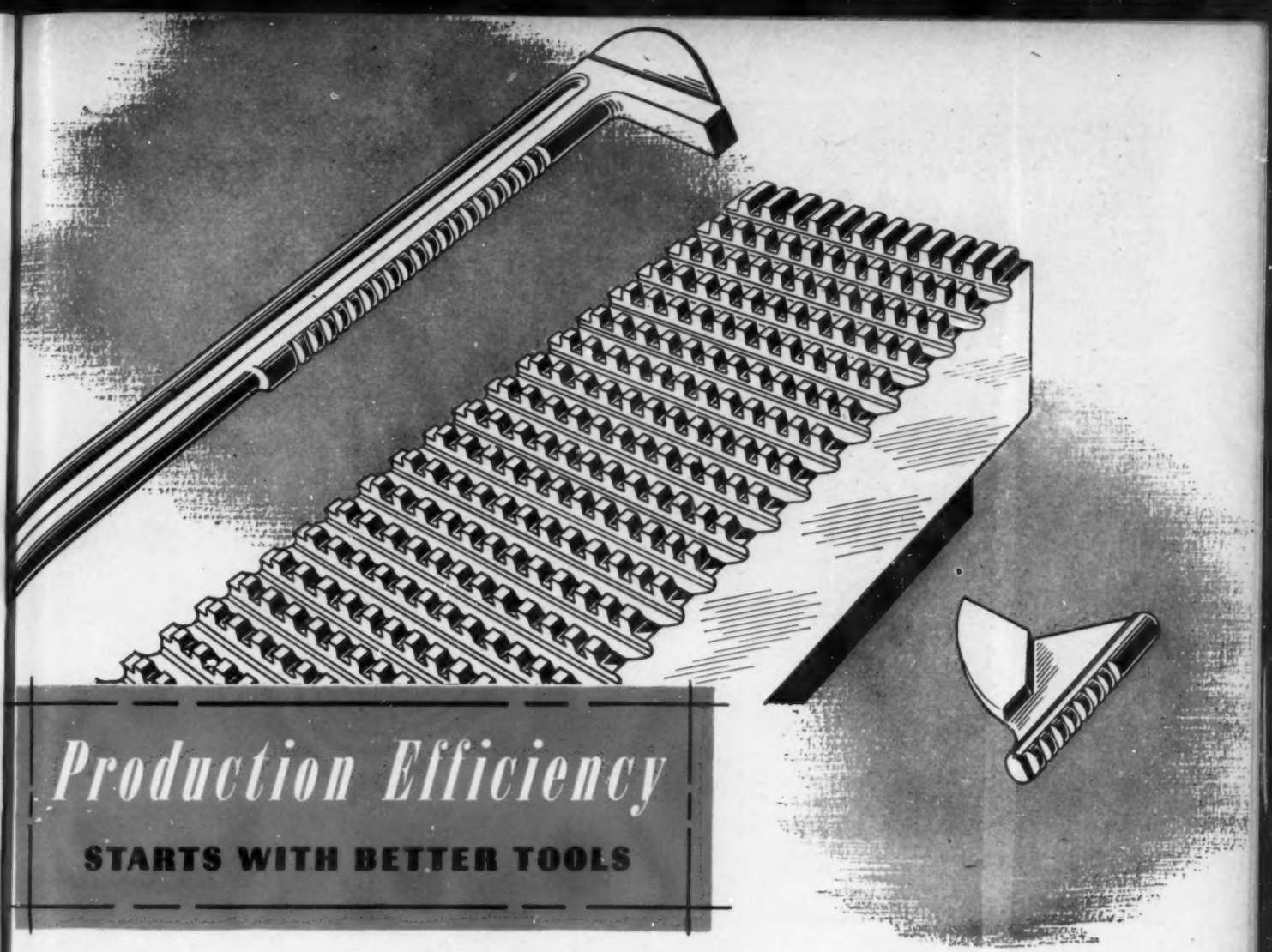

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STARTS WITH BETTER TOOLS

To help you increase machine capacity and improve product quality Illinois Tool offers an experience gained in 34 years of intensive research in the development and application of metal cutting tools specifically designed to meet the requirements of each individual job.

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To accomplish the TASK of delivering a steady oil flow at continuous pressures up to 1000 p.s.i. (1200 in some pump sizes) . . .

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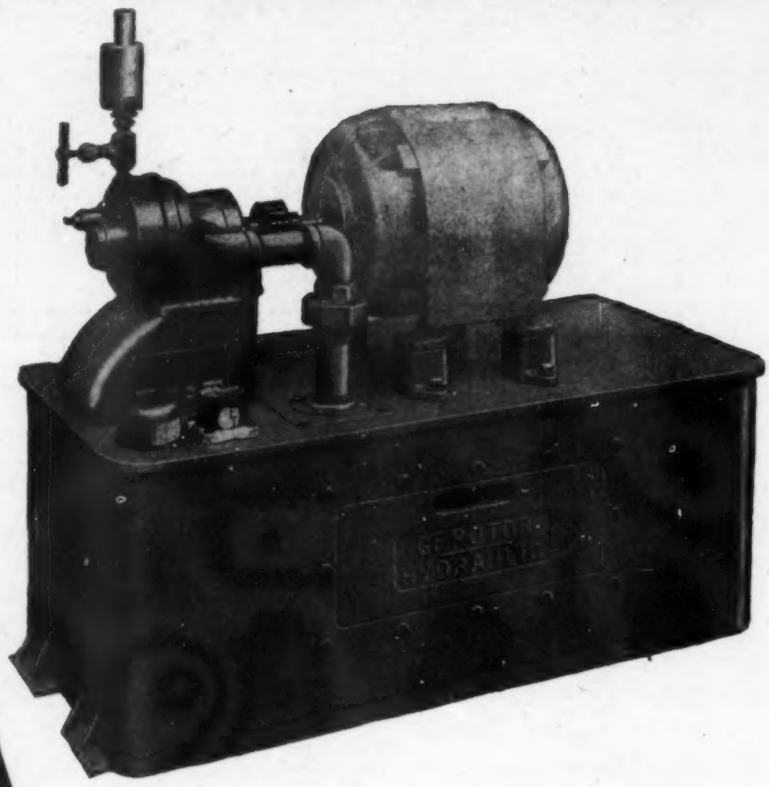
Your most effective FORCE is the unique Gerotor hydraulic pump, built into efficient pump units for either one or two oil circuits.

Like a naval task force, Gerotor hydraulic pump units are planned and equipped for their one specific mission. Complete with tank, relief valve, gauges, filter and coupling. . . for use with standard or special motors. Write for specifications!



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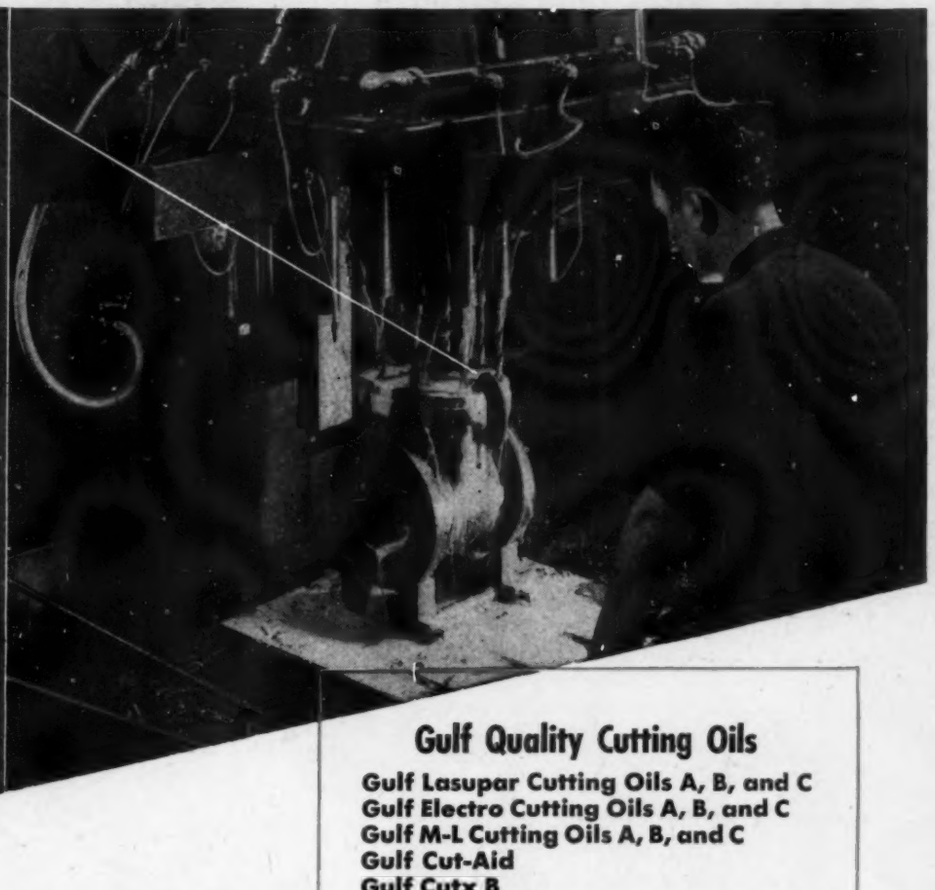
Gulf Soluble Cutting Oil

Helps increase output and tool life!



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GULF SOLUBLE CUTTING OIL is setting new standards of performance for this type of cutting fluid in scores of shops!

Gulf Soluble Cutting Oil combines high cooling efficiency and superior lubricating qualities—a combination that insures maximum production and tool life and fine finishes on the work.

Other quality features of this new Gulf product include improved miscibility, exceptional stability, effective rust preventive properties, pleasant odor—and it's nonfoaming.

Call in a Gulf Lubrication Engineer today and let him demonstrate the many advantages of the new Gulf Soluble Cutting Oil in your shop. Or send the coupon below for folder which gives you further information.

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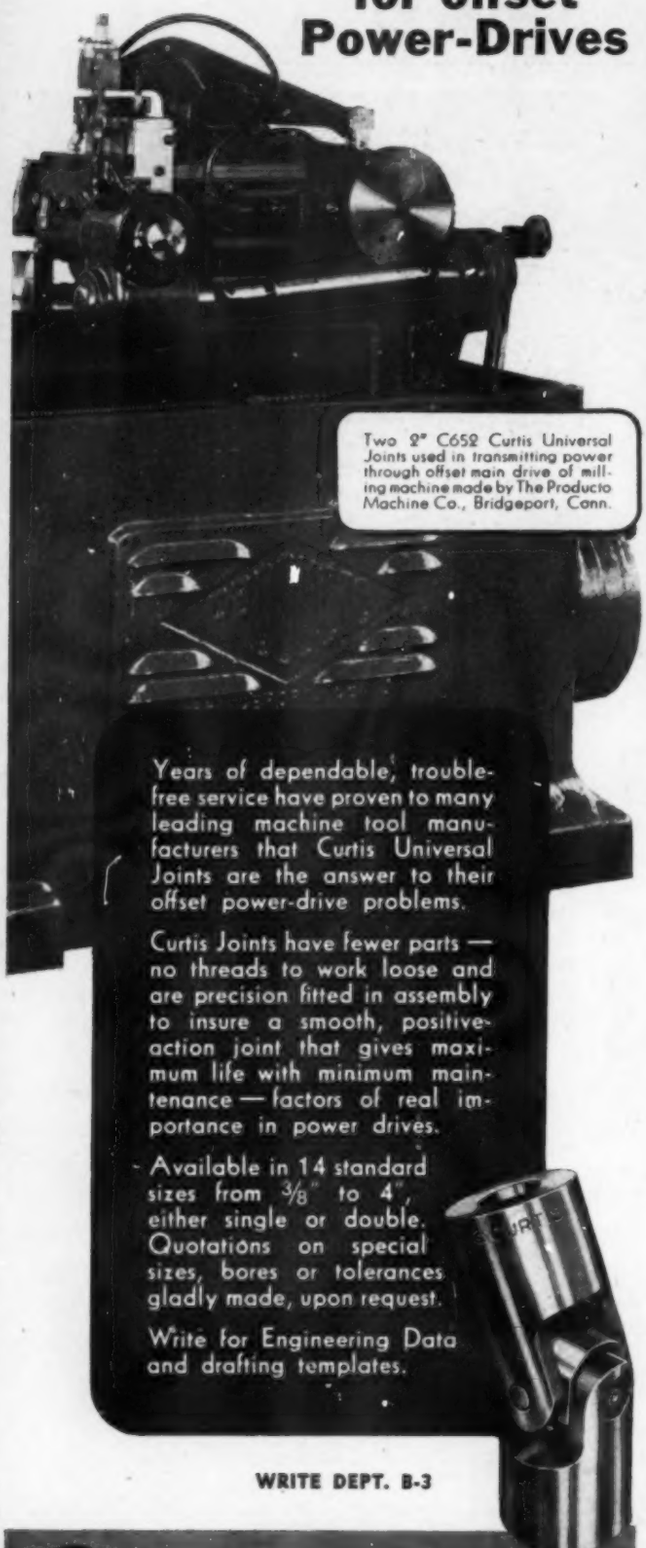
EFFICIENT...

for offset Power-Drives



Two 2" C652 Curtis Universal Joints used in transmitting power through offset main drive of milling machine made by The Producto Machine Co., Bridgeport, Conn.

Years of dependable, trouble-free service have proven to many leading machine tool manufacturers that Curtis Universal Joints are the answer to their offset power-drive problems.

Curtis Joints have fewer parts — no threads to work loose and are precision fitted in assembly to insure a smooth, positive-action joint that gives maximum life with minimum maintenance — factors of real importance in power drives.

Available in 14 standard sizes from 3/8" to 4", either single or double. Quotations on special sizes, bores or tolerances gladly made, upon request.

Write for Engineering Data and drafting templates.

WRITE DEPT. B-3

CURTIS UNIVERSAL JOINT CO. INC. SPRINGFIELD MASS.

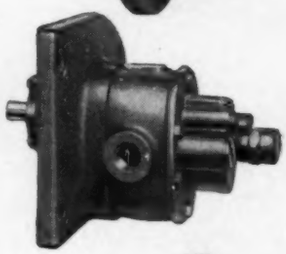
SPECIAL PUMPS FOR YOUR SPECIAL PURPOSES

HERE ARE just a few of the many special pumps manufactured by Brown & Sharpe . . . to do special jobs in many different fields. Besides making pumps with various mountings we make pumps with special internal construction to fit individual requirements... often from stock parts. Write us *YOUR* specifications and also ask for complete catalog of stock pumps. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

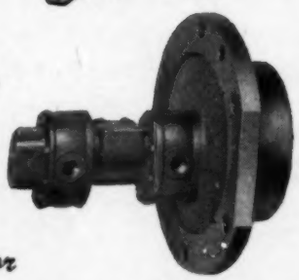
Flange Mounted Rotary Geared Pump readily adapted to many machines.

This Vane Pump with Flange Mounting fits easily into many designs.

Rotary Geared Pump designed for lubrication of Diesel Engines.



Duplex Unit with Flange Mounting. The two pumps, coupled by a flexible drive, can be separated by a suitable seal to pump dissimilar liquids.



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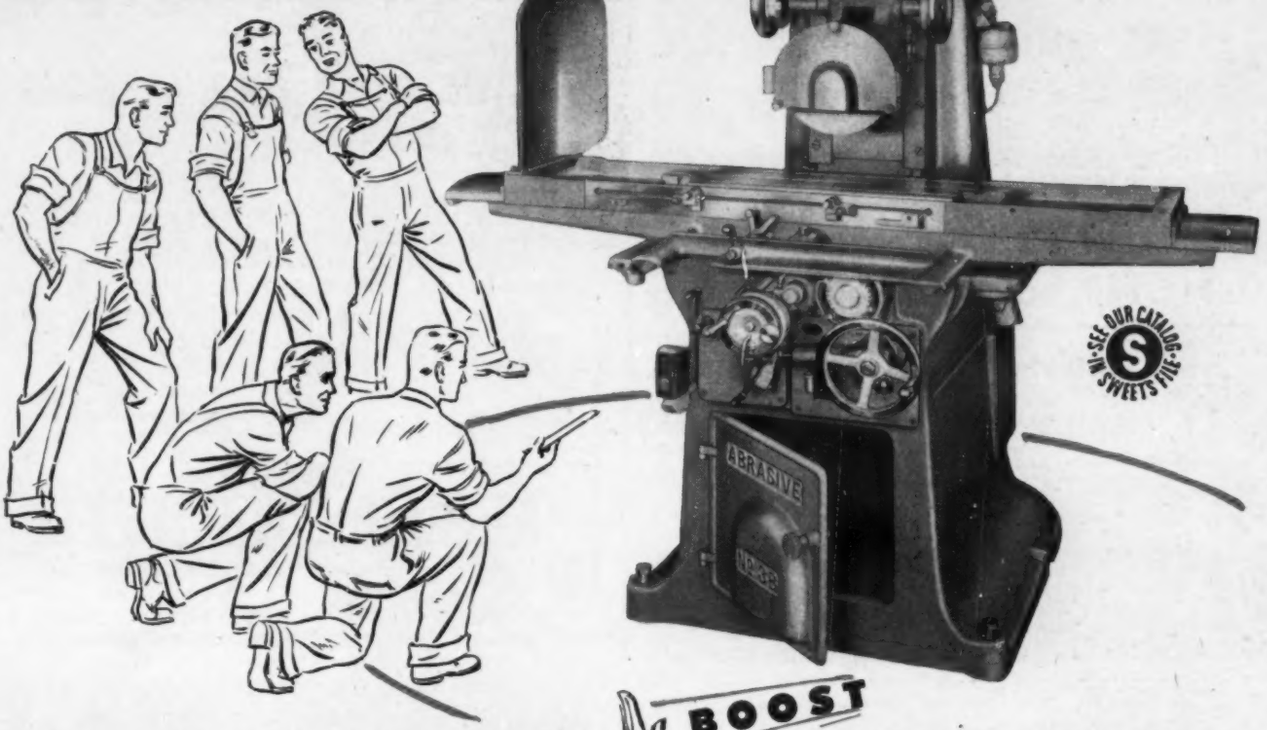
FROM ANY ANGLE



IT'S A MACHINE TO BOOST PRODUCTION

ABRASIVE 3B Surface Grinder

SPEED • ACCURACY • LONG LIFE — ABRASIVE 3B *has them all!*

Fast automatic feeds, with standard table speeds of 20 and 40 feet per minute, help maintain heavy production schedules.

Vertical feed dial is graduated to .0001", for precision work of the highest quality.

Cartridge type spindle of alloy steel, 1⅝" diameter, is carried in adjustable bronze box at front and super-precision ball bearings at rear.

Massive one-piece bed casting — weighing 1540 lbs. — insures perfect alignment and minimizes vibration.

Ask for descriptive bulletin.

SPECIFICATIONS:

Work Capacity: 24" long, 8" wide, 12" high

Wheel Size: Standard 10" wheel. 8" or 12" wheels on order

Drive: 3 H.P. motor in base

Table Size Overall: 59" x 10½"

Net Weight: 2670 lbs.

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If you will send us serial numbers of Abrasive machines on the Government Surplus Tool list we will endeavor to supply you with information, attachments or repair parts.

ABRASIVE

ACCURACY BOOSTS PRODUCTION

ABRASIVE MACHINE TOOL CO.

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Just ONE setting per form
Just ONE continuous motion

"Fluidmotion"* FEATURES:

.0001" accuracy • Automatic Centering • "Fluidmotion" dressing • Dustproof and shatterless • hardened stainless steel • 7" & 14" wheel capacities • Highest quality diamonds.

Prominent users tell us that they consider "Fluidmotion" Radii & Angle Dressers the finest precision dressing instruments procurable—regardless of cost. They obtain greater accuracy, longer wheel life, and much faster setup and operation.

We'll be glad to send you complete information. Write

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NOTHING UP OUR SLEEVES- It's All in the TOOL!

We design particular tools to do particular jobs, easily, precisely, at low cost. No tooling order is too small, no tooling difficulty is too big for us to handle. Your tool designing problems are a challenge to our ingenuity, mechanical skill, and over 40 years of sound experience.

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BUILDING COMPLETE MACHINE TOOLS
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An interesting brochure, entitled "Gear Craftsmanship," will be mailed FREE upon request.

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All Baumbach Die-Sets have demountable Leader Pins and Bushings. This exclusive feature permits removing Leader pins for machine work on the die shoe and assures reassembly without loss of alignment. A big time and trouble saver. Write for Catalog.

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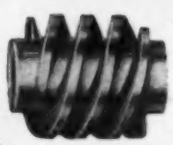
"HARTFORD" for Gears, Cams, Thread-Grinding



OUR SERVICE INCLUDES:

. . . cutting gears of every description exactly to specifications
. . . grinding gears, cams and threads
. . . furnishing aeronautical parts on a contract basis

You plan and we execute—assuring speedy production, prompt delivery and reasonable price. Send blue prints or samples for estimate.

THE HARTFORD SPECIAL MACHINERY CO.
HARTFORD, CONN.

One of the Singer parts — diameter of bore .344", overall length of part 3⅛". Two lands ⅞" long were honed in perfect alignment to extremely accurate bore limits.

Some of the sixteen Sunnen Precision Hones in operation at the Singer plant.

"Unskilled Operators Quickly Hone Parts Accurately within .0001"—on the SUNNEN PRECISION HONING MACHINE"

— Singer Manufacturing Company, Bridgeport, Connecticut

Sunnen Precision Honing pyramided the production of precision parts in this Singer plant. Previously it took twelve weeks to train a worker to lap this part. And even then the job was slow, tedious and often unsatisfactory.

Using the Sunnen Precision Honing Machine, training time was *reduced from twelve weeks to one week.*

In addition, parts were consistently more accurate and more uniform. Use of honing oil permits the use of air gauges without special cleaning of the part — reduces the gauging time.

As a result the Singer plant at Bridgeport is now using sixteen Sunnen Precision Honing Machines to hone all sewing machine parts and accessories that were formerly lapped.

If you produce a part that requires accurate internal diameters within the range of .125" to 2.625", call in a Sunnen engineer. He will show you what Sunnen Honing can do to help your production — or write for bulletin No. XSP5050A.

SUNNEN PRODUCTS CO. • 7941 Manchester Avenue, St. Louis 17, Missouri

Canadian Factory: Chatham, Ontario

The Sunnen Precision Honing Machine Will

- Handle any diameter from .125" to 2.625"
- Produce straight round holes within .0001"
- Produce any surface finish within commercial limit
- Maintain accurate alignment between tandem bores
- Hone any metal (except lead and babbitt), and any plastic or ceramic
- Operate without jigs or fixtures

SUNNEN

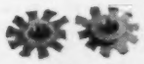
197

Typical Jobs

Inner Bearing Ring "Accurately removes last 'tenth' of stock."

Stainless Steel Load Compensator Valve Seat. Hole is honed to .0002" limit.

Carbureter Idler Valve Jet. Hole is honed after reaming for smooth action.



Calculator Machine Gears. Cut from hole which is reamed and then honed. Honing maintains same pitch line concentricity.

Hydraulic Metering Valve Stem. Hole .56" in diameter; reamed, heat treated, and then honed. Honing 3 times as fast as previous method.

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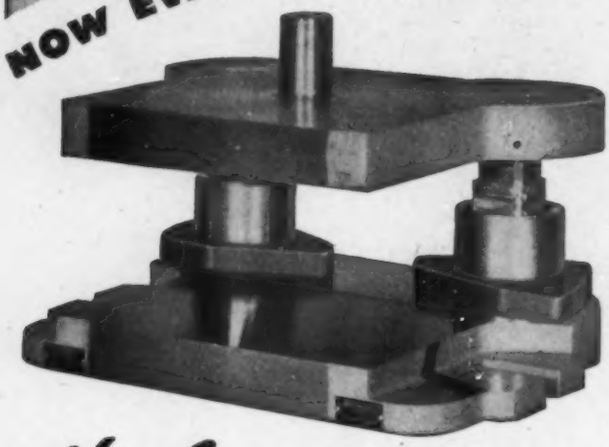

New Speed and Accuracy

...with MICROLEX ANTI-FRICTION DIE SETS

Now Evans offers you the perfect companion pieces for expensive tools and dies. They are Microlex Anti-Friction Die Sets.

Microlex Die Sets have ball or roller bearing guide pins. As a result they make it possible for you to produce parts faster, to tighter limits of accuracy and reduce scrap loss.

Here's why:

Anti-friction guide pins reduce die setter's time . . . enable you to get into production quicker . . . permit fast press speeds. Microlex Die Sets eliminate all down time caused by bound, scored or galled pins. Bearings on these sets have pre-load of .0015" which prevents all possibility of play between guide pins and bushings . . . assures positive accuracy.

You don't have to wait to cash in on the profitable advantages offered by Evans Microlex Die Sets. A large number of sizes are ready for immediate shipment. Phone or write today. We will be glad to help you select the set that meets your exact needs.

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529 S. Main St.
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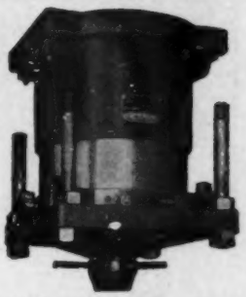
+ INCREASED PRODUCTION
— REDUCED SETUP TIME
= DAYTON ROGERS DIE CUSHIONS



No matter how you figure it Dayton Rogers Die Cushions will assure better results and lower production costs on your punch press operations because:

1. They are readily adapted to either short run quantity requirements or for large quantity production.
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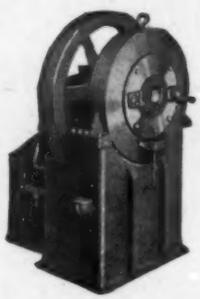

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TORRINGTON
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SWAGING MACHINE

— with 4000 forceful squeezing hammer blows per minute—makes metal tougher and more elastic. Send for booklet—"The Torrington Swaging Machine."

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STRAIGHT SIDE SINGLE CRANK PRESSES
for heavy blanking and forming

Heavier classes of blanking and forming work can be handled efficiently and economically on these presses.

Sturdily constructed with either solid frame or built up with tie rods. Small elastic deflections do not affect tool alignment. All stresses taken centrally. Made also with wedge adjustment for slide for very close work.

Full details on request.

ZEH & HAHNEMANN CO.
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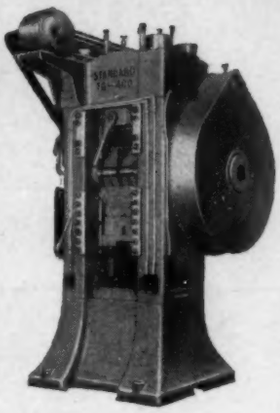
"Standard"
POWER PRESSES

FOR LONG, PRODUCTIVE SERVICE



"Standard" Power Presses speed production operations—blanking, embossing, piercing, forming, drawing or assembling. Ruggedly made in several models—crank or knuckle style, direct or back geared, with solid or inclinable frame—to exactly meet your needs. "Standard" Power Presses and Foot Presses are world-known for their safety, long life and ability to produce.

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MANUFACTURERS OF
Power Presses to 500 Tons • Rolling Mills
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Available for IMMEDIATE DELIVERY

HUB POWER PRESS
for speed, accuracy and economy

These convenient, high speed, power presses will handle materials with ease and convenience. Assures high production of parts at lowest cost.

Made in 4½, 6, 15 and 27 ton capacities

Inquire about the new 27 ton machine.

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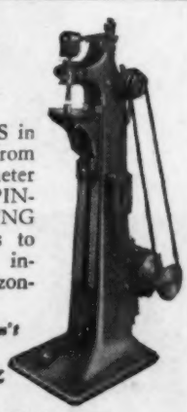
RIVETERS — PIONEERS in their line—head rivets from smallest to ⅝" diameter either by NOISELESS SPINNING or VIBRATING HAMMER method—Sizes to meet all needs—Types include Vertical and Horizontal Multiple Spindles.

Write for literature and don't forget to send samples.



THE GRANT MFG. & MACHINE CO.
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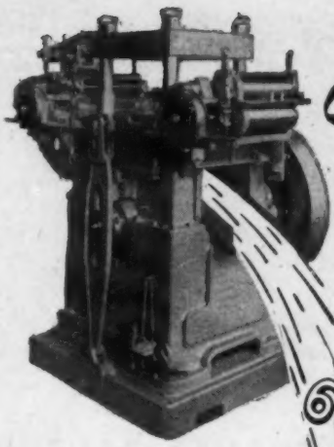


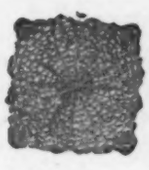
Pays off!

60% TO 90% SAVED

COMPLETE-PER-STROKE STAMPING
Capacities:
10 tons to 300 tons

Plan your quantity stampings for Dieing Machine production. You'll find that this policy PAYS OFF. These unique machines produce simple or intricate stampings COMPLETE PER STROKE with an unmatched combination of High Production and High Precision. Stampings may be consistently held within .0002" limits when required, while the thinnest laminations are produced with perfectly clean edges. Numerous features make this "upside-down" machine a unique automatic press capable of increasing die life 600% to 1200%—more pieces between grinds, less stock ground off to re-sharpen. Get full details of the MANY advantages!

Extruded part produced complete per stroke, 8100 per hour.



Novelty jewelry piece produced complete per stroke.

Can opener blade requiring 8 operations produced complete per stroke at greatly increased rate.

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HENRY & WRIGHT MFG. CO.
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HENRY & WRIGHT DIEING MACHINES

"We Save up to 30% of Production Time

WITH WALKER-TURNER DRILL HEADS IN SPECIAL JIGS"... *Wright Aeronautical Corp.*

"To eliminate costly setup time, a number of small individual jig-drill combinations employing Walker-Turner standard drill units costing $100 to $400 have been installed.

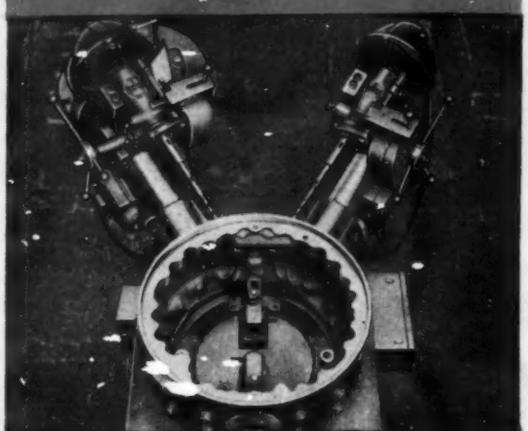
"Housing sections of the Wright Cyclone engine require hundreds of holes of various depths, diameters and angles. With this installation the changing of jigs and fixtures becomes unnecessary.

"PRODUCTION SCHEDULES ALLOWED AS MUCH AS 30% OF TOTAL OPERATION TIME FOR THIS SETUP PROCEDURE. This new method eliminates setup and the possibility of error is reduced.

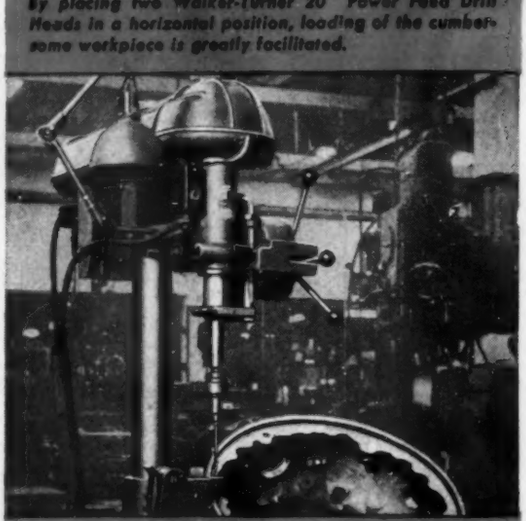
"We now have more than 30 special jig-drill setups employing Walker-Turner Drill Heads in this plant all working to our complete satisfaction."

E. PRANGE, *Supervisor*
Process Engineering
Wright Aeronautical Corp.

Operating on the bottom of the workpiece, two Walker-Turner 20" Power Feed Drill Presses are used in this installation.



By placing two Walker-Turner 20" Power Feed Drill Heads in a horizontal position, loading of the cumbersome workpiece is greatly facilitated.



Two angular oil passages drilled into distributor pads with Walker-Turner 20" Power Feed Drill heads.

TWENTY-FIFTH YEAR
1922 1947

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MACHINE TOOLS

DRILL PRESSES—HAND AND POWER FEED • RADIAL DRILLS • RADIAL SAWS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

FREE LITERATURE

New Catalogs, Booklets, Bulletins

(Not good after July 1, 1947)

MACHINES AND ATTACHMENTS

1 RADIAL DRILLS — Western Machine Tool Works, Holland, Mich. 20-page catalog describes and illustrates heavy-duty radial drills with 16 spindle speeds, built in seven sizes from 3 to 8 ft.

2 TAPPING ATTACHMENT — Procunier Safety Chuck Co., Chicago 6, Ill. 4-page bulletin 946 on attachment which enables tap to idle in tapping direction includes Tru-Grip tap holder, and tapping heads. 2-page bulletin on Style C friction tap holder also available.

3 SURFACE GRINDERS — Hanchett Mfg. Co., Big Rapids, Mich. 10-page bulletin 847-1 describes vertical-spindle surface grinders, reciprocating-table models 200A, 300, 400 and 400SS. Includes applications.

4 PITMAN—Dayton Rogers Mfg. Co., Minneapolis 7, Minn. 4-page bulletin describes hydraulic overload pitman for punch presses. Designed to prevent damage to crankshafts, press frames and tools and dies.

5 LATHES—South Bend Lathe Works, South Bend 22, Ind. 8-page catalog 13-F describes toolroom and quick-change-gear lathes with 13-in. swing. Includes accessories.

6 SWAGERS — Langelier Mfg. Co., Providence, R. I. 8-page bulletin describes hot- or cold-swaging machines, Types A to L inclusive. Includes bench model and models with hydraulic feed. All spindles mounted on Timken roller bearings.

7 FRICTION SAWING—The Tannewitz Works, Grand Rapids 4, Mich. 32-page booklet includes description, by Arthur A. Schwartz, chief tool research engineer, Bell Aircraft Corp., of friction sawing, which burns rather than cuts. Tannewitz high-speed bandsaws illustrated.

8 PRESSES—Logansport Machine Co., Inc., Logansport, Ind. 24-page catalog 51 describes and illustrates hydraulic and air presses. Includes low-platen, high-platen, utility, special and arbor presses.

9 AUTOMATIC FEEDS—F. J. Littell Machine Co., Chicago 13, Ill. Catalog 46 covers punch-press rack-and-pinion roll feeds, straightening machines, air-blast valves, and dial, magazine and hopper feeds. Includes reels for coil stock.

10 HACKSAWS—Miller-Knuth Mfg. Co., Omaha, Nebr. Three 2-page bulletins cover three portable self-contained Sawmaster power hacksaws. 6 x 6-in. model has automatic shut-off switch and length gage for cutting duplicate parts.

11 DRILLHEADS — Commander Mfg. Co., Chicago 24, Ill. 4-page bulletin 3-47 describes 6- and 8-spindle drillheads, which adjust to any pattern, fit any drill-press, and drill at one stroke as many holes as there are spindles.

12 HACKSAWS — Maquoketa Co., Maquoketa, Iowa. 4-page bulletin describes SawMore heavy-duty hacksaws, models V, GB and GB automatic, with capacities of 10x10 or 6x6 in.

13 CHAMFERING—The Cross Co., Detroit 7, Mich. 10-page booklet describes 60 Series chamfering machines and explains high-speed gear-tooth pointing and chamfering methods.

TOOLS AND ACCESSORIES

14 BALANCING MACHINES—Industrial Div., Bear Mfg. Co., Rock Island, Ill. 16-page bulletin describes Bear machines used to determine balance of rotating parts including wheels, armatures and rotors.

15 TOOLS—Schmarje Tool & Engineering Co., Muscatine, Iowa. 12-page catalog 146 describes carbide-tipped tools such as reamers, counterbores and form tools. Includes carbide tipped centers.

16 CHUCK—Whitman & Barnes, Detroit 16, Mich. Folder covers Micro-chuck, which consists of chuck and collet, the latter said to adjust to absolute concentricity. List of Micro twist drills and watchmakers' drills included.

17 GAGES—Sturdy Tool & Gage Co., Detroit 27, Mich. 4-page bulletin SG-8-46 describes steel, chrome-plated, tungsten-carbide and Norbide gages including snap, plug and ring gages.

18 DIAMOND TOOLS—Champion Diamond Co., New York, N. Y. 4-page circular describes various diamond tools used to dress grinding wheels. Includes new tools in addition to regular line.

19 COMPARATOR SCREENS — Jones & Lamson Machine Co., Springfield, Vt. 28-page catalog on standard glass screens for all models of Jones & Lamson comparators. Includes screens with outlines on front surface, and overlay screens with outlines on back.

20 TOOLS — The Collis Co., Clinton, Iowa. 36-page catalog 36 describes and illustrates tools such as arbors, chucks, collets, centers, sleeves and sockets. Includes tables on tapers.

HEAT-TREATING AND WELDING

21 INDUCTION FURNACES — Ajax Electrothermic Corp., Ajax Park, Trenton 5, N. J. 8-page bulletin 12-A describes small 3- and 6-kw. spark-gap converters used in induction heating, brazing, hardening and melting. Includes coils and melting furnaces.

22 ARC WELDING—Eutectic Welding Alloys Corp., New York 13, N. Y. 4-page brochure "Arc Welding at Lower Base Metal Temperatures," gives information on "Low-Temp" Eutectrodes (welding rods) for arc welding.

23 OXYACETYLENE CUTTING—Air Reduction Sales Co., New York 17, N. Y. 12-page pamphlet describes oxyacetylene machine cutting applications. Covers electronic tracer, hot cutoff machines, scrap cutting and other adaptions.

24 CRUCIBLE FURNACES—Hevi Duty Electric Co., Milwaukee 1, Wis. 4-page bulletin HD-1246 describes Multiple Unit, Hevi Duty and Square crucible furnaces.

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25 REFRACTORIES—Norton Co., Worcester 6, Mass. 22-page catalog 803-9P describes Alundum and Crystolon refractories. Includes tables of properties, selection, brick, conversion factors and atomic weights.

26 SEAM WELDERS—Progressive Welder Co., Detroit 12, Mich. 8-page bulletin 803 describes light-, medium- and heavy-duty standard seam welders. Each size available in circular, longitudinal and universal types.

PLANT SERVICE EQUIPMENT

27 AIR FILTERS—American Air Filter Co., Inc., Louisville 8, Ky. 24-page booklet discusses industrial dust problems and typical applications of AAF air filters, including cooling equipment.

28 STEEL STRAPPING—The Stanley Works, New Britain, Conn. 8-page bulletin describes "Uni-Tie" system of steel strapping for skid or palletized loads. Includes Ace automatic seal feed.

29 MATERIALS HANDLING—Metzgar Co., Grand Rapids 4, Mich. 6-page bulletin describes equipment such as wheel and roller gravity conveyors, accessories, portable power conveyor, casters and wheels.

30 HOISTS—Industrial Equipment Div., The Master Electric Co., Dayton 1, Ohio. 4-page bulletin describes 250 to 6000-lb. capacity Speedmaster electrically controlled hoist and 250- to 1000-lb. capacity Cablemaster manually controlled hoist.

31 INDUSTRIAL MODELS—Stark Industrial Models, New York 14, N. Y. 4-page booklet illustrates types of three-dimensional custom-made models used to aid production.

32 LIFT TRUCK—Lift Trucks, Inc., Cincinnati 14, Ohio. 6-page catalog describes motorized HydroLectric 4000-lb. lift truck with fingertip control on handle.

33 FLOORING—Walter Bates Co., Inc., Joliet, Ill. 4-page bulletin covers Bates Grates open steel flooring with fillet-welded hex crossbars.

34 TRUCKS—Automatic Transportation Co., Chicago 20, Ill. 8-page bulletin describes 4000-lb. platform, open-face, straddle or suspended-load type high-lift Transtacker. Truck has electric propulsion and electric hydraulic lift.

35 DRAWING MACHINE — Pomeroy Stereograph Co., Inc., Cleveland 14, Ohio. 8-page bulletin PS-47 describes Pomeroy Stereograph, a perspective-drawing instrument which automatically provides for vanishing points. No grids needed.

PARTS AND MATERIALS

36 FASTENERS—The B. F. Goodrich Co., Akron, Ohio. 40-page booklet gives data on "Rivnuts," one-piece blind fasteners which serve as blind rivets, nut plates for attachment, or both. Made of aluminum, steel and brass.

37 ALLOY — Ampco Metal Company, Inc., Milwaukee 4, Wis. 4-page bulletin 57A describes machine-tool applications of Ampco Metal, an alloy in six grades composed of copper, aluminum and iron. Includes table on properties of sand castings.

38 CENTRIFUGAL PUMPS — Quimby Pump Div., H. K. Porter Co., Inc., Pittsburgh 22, Pa. 8-page Bulletin 300-A describes model "Q" close-coupled general-service centrifugal pumps with capacities from 10 to 1,000 gpm.

39 REMOTE TRANSMISSION — The Brown Instrument Co., Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa. 24-page booklet 5902 on New-Matic (pneumatic) remote transmission systems for applications where electrical transmission for indicating, recording and control is not desirable.

40 CHAIN BELTS—The Chain Belt Co., Milwaukee 4, Wis. 12-page bulletin 46-10 on REX cast and steel chain belts for drive and conveyor service. Includes all standard chains, typical installations.

41 CUTTING OIL—Industrial Products Dept., Sun Oil Co., Philadelphia 3, Pa. 4-page bulletin covers "Sunicut 11" straight cutting oil for automatic machines. Includes descriptions of various cases.

42 PIPE MATERIALS—Tube Turns, Inc., Louisville 1, Ky. Chart lists pipe and fitting materials, including specifications, chemistry, temperature limits and welding data.

43 FLANGES—Kropp Forge Co., Chicago 50, Ill. 16-page bulletin, "Stock Flange List No. 225," describes and illustrates forged steel flanges. Includes sectional drawings, specifications and price lists.

44 INDUCTION MOTORS — Reliance Electric and Engineering Co., Cleveland 10, Ohio. Two 4-page bulletins describe Series C induction motors. Bulletin C-118 covers ½- to 20-hp. protected (open type) frame sizes 203 to 326, and C-125 covers totally enclosed squirrel-cage frame sizes 224 to 326.

45 CLUTCHES—Carlyle Johnson Machine Co., Manchester, Conn. Catalog 47 covers Maxitorq floating-disk clutch and Maxitorq automatic overload-release clutch. Standard clutch is available to 15 hp. at 100 rpm., and overload clutch up to 5 hp.

46 SCREWS — Continental Screw Co., New Bedford, Mass. Two folders describe Holtite screws, bolts, nuts, and Holtite "Tap" self-tapping screws which act as two-fluted taps and can cut threads in plastic and cast iron.

47 VALVES—Worthington Pump and Machinery Corp., Harrison, N. J. 8-page bulletin includes Worthite gate valves, needle valves, pipe, centrifugal-cast tubes, hot-rolled tubes, forgings, wire and electrodes.

48 GENERATORS — Century Electric Co., St. Louis 3, Mo. 8-page bulletin 646 describes generators and motor-generator sets. Dc. generators are 50 w. to 200 kw., and ac. generators are 500 w. to 150 kw.

49 BALL BEARINGS—Miniature Precision Bearings, Inc., Keene, N. H. 4-page bulletin 4b on miniature ball bearings describes five series: radial, superlight, radial, pivot, angular contact and thrust.

50 GENERATOR PLANTS—The Master Electric Co., Dayton 1, Ohio. 8-page bulletin describes generator plants from 500 to 17,000 w., ac. and dc., driven by gasoline or diesel engines.

51 CASTINGS—Meehanite Metal Corp., New Rochelle, N. Y. Periodical news bulletin will cover developments in applications of Meehanite castings in industry. First booklet, 8-page Bulletin 24, now available.

52 GRINDING OILS—D. A. Stuart Oil Co., Chicago 23, Ill., 12-page booklet, "Grinding with Oil," provides information on selection, gives examples of use, and describes properties of grinding oils.

53 INDUCTION MOTORS—Apparatus Dept., General Electric Co., Schenectady, N. Y. 8-page bulletin describes Tri-Clad vertical induction motors for pump drive. Motors are from 1 to 500 hp., all speeds and frequencies, and are shielded.

54 ROLLER BEARINGS—McGill Mfg. Co., Inc., Valparaiso, Ind., 6-page bulletin describes Cam Follower full-type needle roller bearings, giving specifications and capacities. Also available are 12-page bulletin M-40 and 16-page SM-42A on Multirol and Soldidend Multirol bearings.

MISCELLANEOUS

55 POSTER—Koebel Diamond Tool Co., Detroit 13, Mich. Poster warns diamond-tool users to handle tools carefully. Intended for posting in the plant, it supplements the booklet, "For Grinder Men Only."

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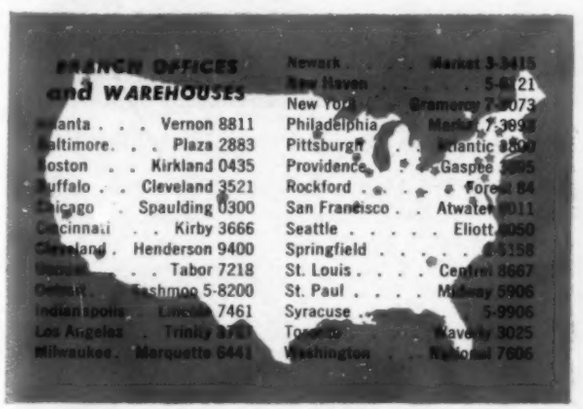
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❹ Tool Steel for the Non-Metallurgist
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❺ Characteristics of Rezistal Stainless Steels
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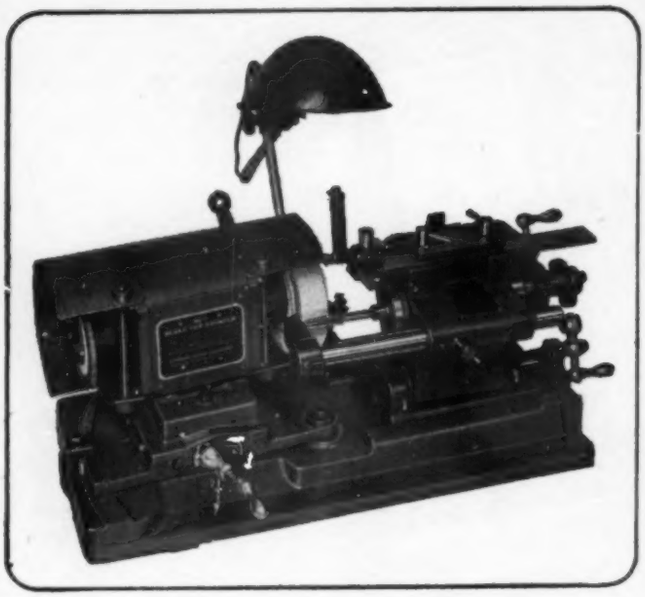

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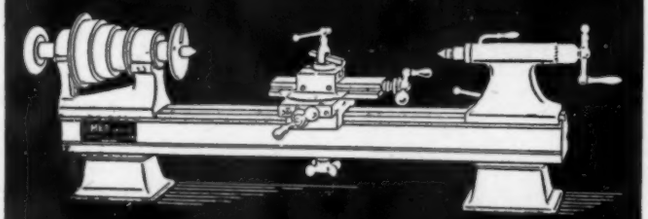

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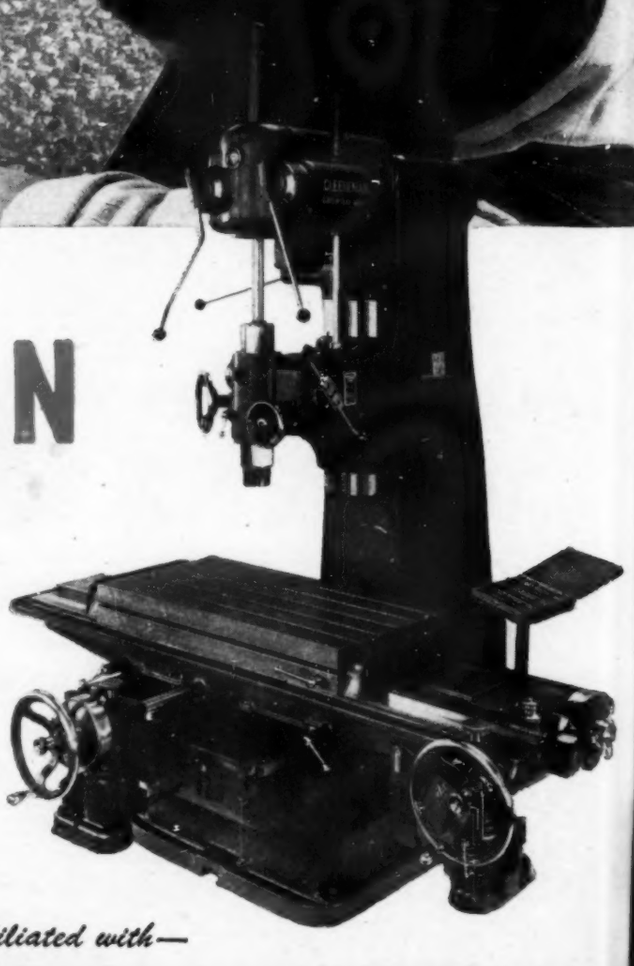

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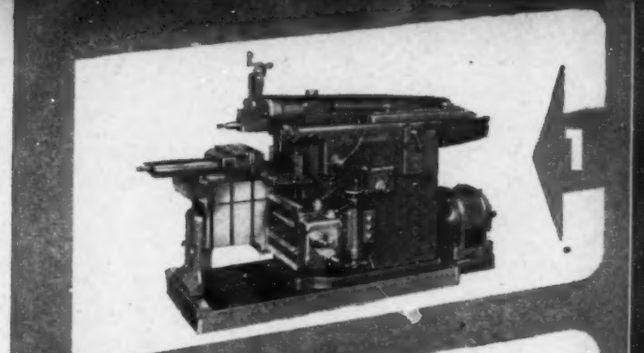

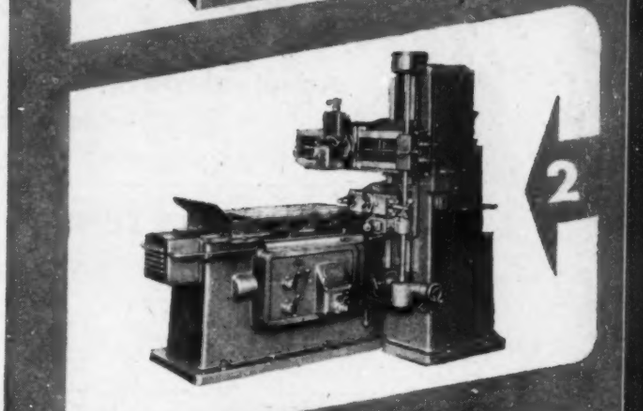

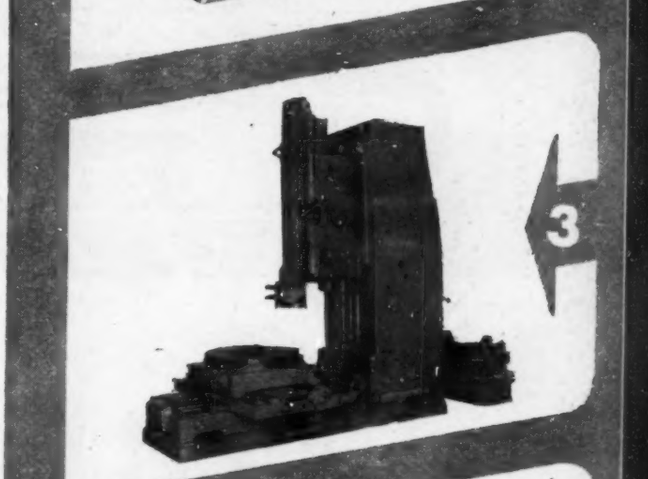

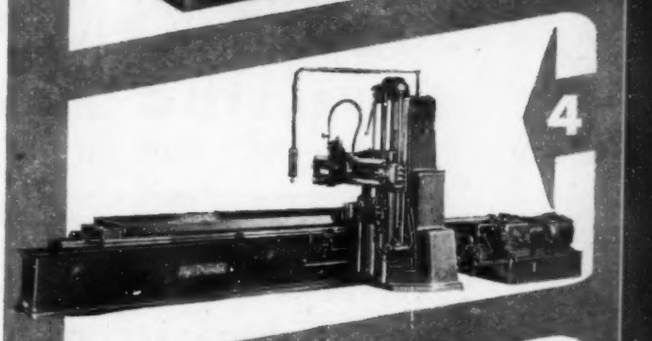

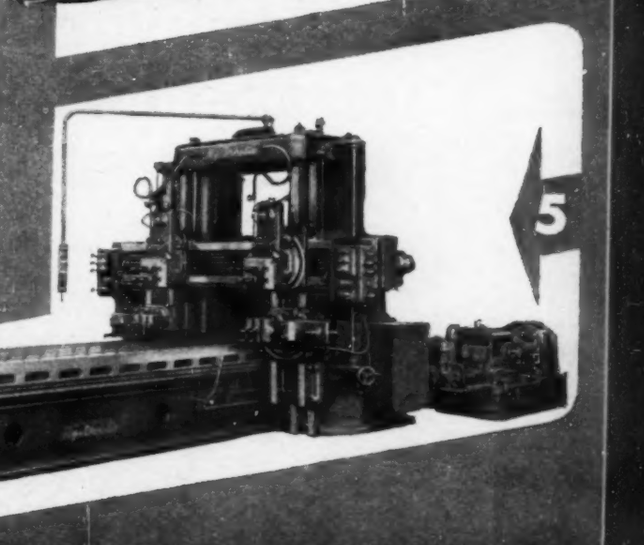

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3 Spindle Head			$150.00	6 Spindle Head			$170.00
4	"	"	155.00	7	"	"	180.00
5	"	"	160.00	8	"	"	200.00

US HEADS SINCE 1915

• *Delivery in Two Weeks*

UNITED STATES DRILL HEAD CO.
CINCINNATI 4, OHIO

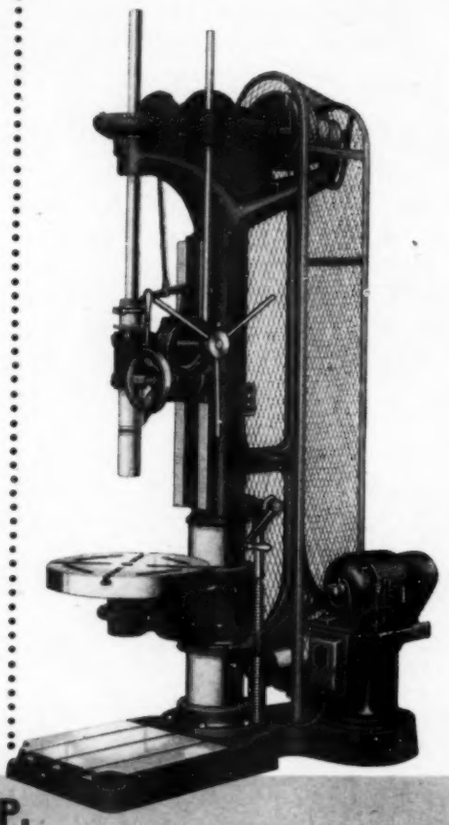
SIBLEY

DRILLING MACHINES

24" and 28" Swing

- GREATER PRODUCTIVITY
- LOW INITIAL COST
- LOW MAINTENANCE
- LONG LIFE
- EASY OPERATION
- IMMEDIATE DELIVERY

WRITE FOR CATALOG NO. 66



SIBLEY MACHINE & FOUNDRY CORP.
30 EAST TUTT STREET, SOUTH BEND, IND.

ANY GOOD CUTTING FLUID WILL HELP YOU GET LONGER TOOL LIFE —FINER FINISH

BUT ONLY ANTISEP PROVIDES THESE, TOO:

Antisep Soluble Oil, in addition to the unusual and exclusive merits headlined at the right, has other features that will appeal to machine operators and management:

It is highly concentrated and can be used in greater dilution, hence is economical.

Because it will not load up grinding wheels, it prevents blueing or discoloration of the work—too often a problem when grinding.

And it aids the fight against rust of machined work. Even at high dilution with water, it provides a film of polar characteristics, tending to displace water and protect against rust.

Buy Antisep and you buy the best in water-soluble cutting oils!

1. ANTISEPTIC TREATMENT

Operators like it because it's kind to hands and does not turn rancid.

2. REMARKABLE CLEANSING POWER — No gumming or clogging of lines.

HOUGHTON'S

ANTISEP

SOLUBLE OIL

The oil that's changing cutting fluid standards

no axe to grind

Because . . .

JESSOP manufactures

every type of tool material

for every cutting operation

● The Jessop representative, with *complete* line of tool materials to offer, has no axe to grind and therefore will recommend the most suitable material for your needs. You will find him cooperative and helpful in solving your machining problems. Send for him today . . . or write direct for descriptive literature.

JESSOP High Speed Steels JESSOP has been a leading producer of high speed steel since the first world war and has pioneered many improvements in this field. JESSOP High Speed Steels are furnished in all types, including straight tungsten, tungsten-cobalt, and tungsten-molybdenum analyses, and in all commercial shapes such as bars, sheets, drill rod, and finished tool holder bits.

JESSOP "Malta" Carbides Keeping pace with the latest developments in tool materials, JESSOP manufactures "MALTA" Carbide tools and tool tips for very high machining production. JESSOP "MALTA" Carbide tools and tool tips are furnished in standard sizes and shapes and grade of carbide for practically every machining operation. Special tools are manufactured to customer's specifications.

JESSOP "T & V" Cast Alloy An "intermediate" tool material, JESSOP "T & V" Cast Alloy is harder than high speed steel but tougher than cemented carbide, and is used for applications where machining speeds combined with good shock resistance are required. JESSOP "T & V" Cast Alloy tool bits are stocked for immediate shipment.

Jessop Steel Company

WASHINGTON, PENNSYLVANIA

Tailor-made Specialty Steels

IMPROVED HEAT PROCESSING OF METALS

A fast-heating process, which breaks sharply from conventional practices as a technique and as a producer of improved heating results, has been quietly establishing itself in mills and plants where metal heating, reheating and heat-treating are production operations.

The process is new. One of the commonest of industrial fuels—commercial gas—is caused to give results of a new order in speed and quality.

Equipment which applies and controls the heat is unlike that for any other technique. It represents a distinct development. For this reason, the identifying name—GRADIATION—can be helpful to men in industry who are moved to study the process and its record.

The booklet illustrated here offers a review of Gradiation in the metals industry. It is a summary of principles and specific performances.

SPEED
—improves mill and plant schedules; reduces conventional hours to minutes or seconds.
IMPROVED PRODUCT
—better metallurgical characteristics from speed and automatic process-control.
SAVINGS
—in processed metal, rejects, space, time, fuel, handling, straightening, pickling, quenching.
USED FOR
—through heating for heat treating, forging, extruding, upsetting; annealing; hardening followed by tempering; surface hardening and patterned, localized heating or heat-treating.
CONTINUOUS PRODUCTION
—for ferrous or non-ferrous bars, tubes, billets, strip, wire, castings, slugs or machined parts.
UNIFORM RESULTS
—by exact reproduction in continuous or repetitive operations.
COMFORT
—with ease and safety for the operator.
FLEXIBILITY
—in accommodating size-variety in one heating arrangement.
Slug heating for forging

The name Gradiation implies *radiation*—high speed, high temperature, solar-like heat; it implies *gradient*—faster heating by exposing metals to superheat with precise control of heating rate; it implies *gas-radiation*—which protects the charge and is economical to apply.

Gradiation is a development of Selas engineering. Whether your work with metals is producing or processing, ferrous or non-ferrous, send for the book. Ask of existing installations or of the adaptability of Gradiation to your work.

IMPROVED HEAT PROCESSING

*SELAS TRADE NAME

SELAS CORPORATION OF AMERICA PHILA 34 PA

IN PARTS PRODUCTION...

Leadership BUILDS ON *Craftsmanship*

WINTER Tapper Taps are designed to thread enormous quantities of nuts on a rapid production basis. Straight shank tapper taps (in four different styles) and bent shank tapper taps are available for use in various types of nut tapping machines. The threaded section of WINTER Tapper Taps is made as short as possible to insure smooth operation and satisfactory results. For threading nuts in small quantities, WINTER Regular Nut Taps are recommended.

YOUR LOCAL DISTRIBUTOR carries a complete stock of WINTER Taps on his shelves—as close to your tapping problems as the phone on your desk.

Craftsmanship of the highest order always has been employed in the manufacture of WINTER Taps.

Winter Brothers COMPANY

WRENTHAM, MASS. and ROCHESTER, MICH. • Distributors in Principal Cities
A Division of the National Twist Drill and Tool Company • Branch Stores: San Francisco, Chicago, Detroit

...AND AT ASSEMBLY

NATIONAL produces a complete line of End Mills, in a wide variety of sizes and types. Shown below is one of NATIONAL'S Helex Fast Spiral End Mills, designed with high helex angle cutting edges for smooth action. With these mills, smooth, efficient operation is possible even at high speeds and feeds. Production is increased, breakage reduced, when you specify NATIONAL End Mills, part of NATIONAL'S complete line of Rotary Metal Cutting Tools.

Craftsmanship **INSURES** *Quality*

The skill and facilities to make NATIONAL Tools the best you can buy are supplied at NATIONAL'S great new plant in Rochester, Michigan.

LEADING DISTRIBUTORS EVERYWHERE offer complete stocks of NATIONAL Cutting Tools and factory-trained men to serve you. Call them for cutting tools or any staple industrial product.

NATIONAL TWIST DRILL AND TOOL COMPANY

ROCHESTER, MICHIGAN, U. S. A. Distributors in Principal Cities

Factory Branches: New York • Chicago • Detroit • Cleveland • San Francisco

Whether you're in a hurry—
or have lots of time—call us for
Steel

UNITED STATES STEEL SUPPLY COMPANY
USS
STEELS
SERVICE

Symbol of Service
FOR STEEL USERS

We hope you aren't always in a "jam" when you call us for steel. But when you are, we will give you the fastest possible service. And for anticipated needs, you can depend upon us to give your orders exacting attention.

Whether you need a pound or a ton of steel—whether you require Stainless, High Strength or Alloy Steels . . . Hot Rolled or Cold Finished Bars, Structural Shapes, Plates, Sheets, Machinery, etc. —call, wire or write our warehouse nearest you for prompt, dependable service.

United States Steel Supply Company

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BALTIMORE (3)	Bush & Wicomico Sts., P. O. Box 2036	GIlmor 3100
BOSTON	176 Lincoln St. (Allston 34), P. O. Box 42	STAdium 9400
CLEVELAND (14)	1394 East 39th St.	HEnderson 5750
MILWAUKEE (1)	4027 West Scott St., P. O. Box 2045	Mitchell 7500
NEWARK (1), N. J.	Foot of Bessemer St., P. O. Box 479	Bigelow 3-5920 REctor 2-6560 BErgen 3-1614
PITTSBURGH (12)	1281 Reedsdale St., N. S.	CEdar 7780
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UNITED STATES STEEL

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FIRST . . . if you want tools that LAST!

These days, the lasting quality of Haskins Flexible Shaft machines is minimizing production difficulties and delays wherever they're at work. Many 20-year-old Haskins portable tools are still on the job: and their usefulness covers everything from die polishing and buffing to heavy duty sanding and rotary filing!

It's an asset, this Haskins quality—an asset that stands ready to help you.

Send for full information.

R. G. HASKINS COMPANY,
2641 W. Harrison St.,
Chicago 12, Illinois.

HASKINS

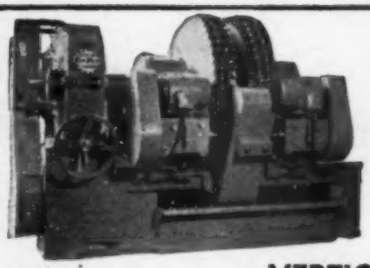
HC-5, ½ H.P. Multi-speed countershaft unit. 750 to 3900 RPM. Bench-height pedestal. 360° motor swivel.

haskins
FLEXIBLE SHAFT EQUIPMENT

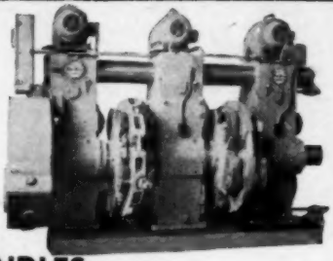
If you wear glasses, the chances are that your eye comfort depends upon some Geometric threaded screws. A number of leading optical companies rely on Geometric tools for threading the tiny screws that hold the glasses frame together. The tool selected for this exact fine pitch threading is the Geometric Style EJ5 Solid Adjustable Die Head. Consistently accurate, the Style EJ5 can cut threads as small as 1/16" in diameter, with 80 or so threads per inch. It is small, light in weight, but rugged, nevertheless, and has been known to thread more than 103,000 pieces without a grind, whereas average production with solid dies ran around 13,000 to 15,000 pieces.

The Style EJ5 is but one of the many superior Geometric Die Heads, famous for more than 50 years as the best in screw threading tools. *Write today for complete information on the entire Geometric line.*

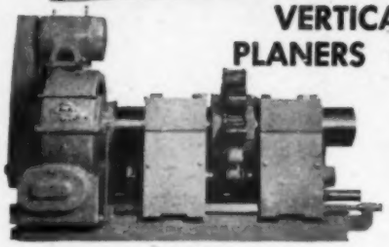
THE
GEOMETRIC
TOOL COMPANY · NEW HAVEN 15, CONN.
A Division of Greenfield Tap and Die Corporation



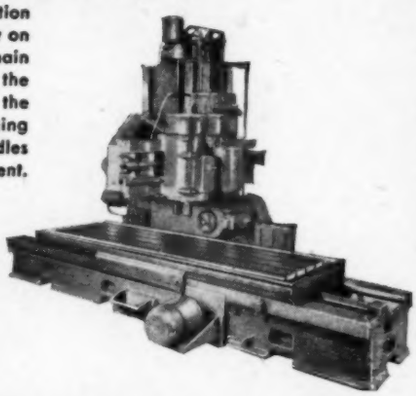
Roto-Matic MILLERS

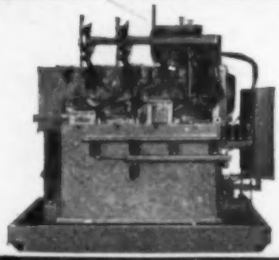


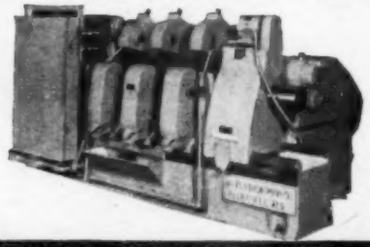
ROTARY DRUM TYPES •
VERTICALS • SINGLE AND MULTIPLE SPINDLES
PLANERS • RISE AND FALL • VERTICAL INDEXING



The ROTO-MATIC principle of continuous production insures the maximum of production and accuracy on any job to which a Miller has been adapted. Chain clamping mechanisms, where adapted, leave the operator free to load and unload parts. On the larger type Rotary Drum Type Millers finishing spindles are adjustable for toe cut. All spindles have provisions for micrometric endwise adjustment.







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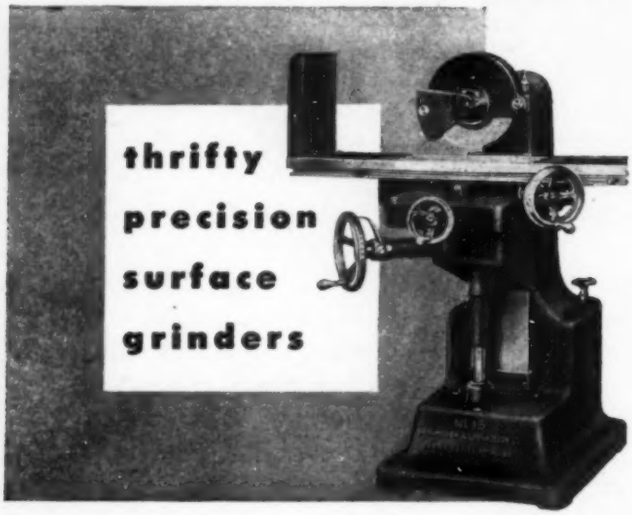
DAVIS & THOMPSON COMPANY

MANUFACTURERS MACHINE TOOLS, MICROMETERS AND GAGES

MILWAUKEE WISCONSIN



This Grand Rapids No. 15 Motor Driven Hand Feed Surface Grinder can, in many instances, be used more profitably than the more costly Hydraulic Feed Surface Grinders . . . and we make both types.

Write for descriptive bulletin

GALLMEYER & LIVINGSTON COMPANY
Manufacturers of Grand Rapids Grinders
330 STRAIGHT ST., S. W., GRAND RAPIDS 4, MICH.

Investigate

THE POSSIBILITIES OF THE NATIONAL KEYSEATING MILLER *on Your Work*

• Shops all over the country are solving difficult keyseating problems by chucking this attachment on their drill presses, radials and horizontal boring mills—and milling keyseats in pieces too large or bulky for convenient handling on keyseating machines.

The "National" goes through the hole once and mills keyseats with parallel sides and parallel with the axis of the bore. It's a big time and money saver and is available in standard stock diameters from ½" to 3½" for cutting lengths from 1⅞" to 12". It will keyseat in blind holes, and offset holes. We also manufacture oil-grooving millers.

Several widths of cutters can be used with each size miller and many different hole diameters keyseated with one tool through the use of eccentric bushings.

WRITE today for Catalog No. 16

NATIONAL MACHINE TOOL CO.
CINCINNATI, OHIO

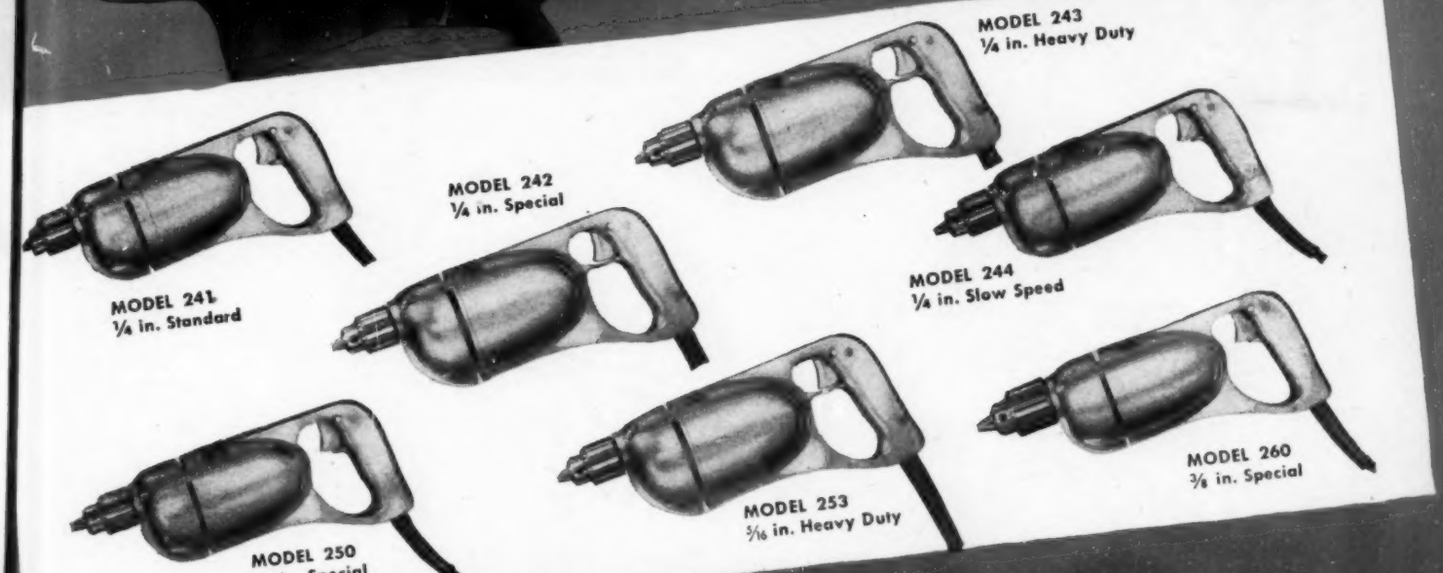
ANNOUNCING

7 NEW SKILDRILLS . . .

7 NEW GOOD REASONS TO

SKILDRILL IT!

• The new SKILDRILLS you've wanted and waited for are here. They're new in design and engineering . . . in lightness and compactness . . . in drilling speed and power. New SKILDRILLS will bring you better, faster, easier drilling and longer service on every job. Ask your distributor about a demonstration TODAY!



ELECTRIC PNEUMATIC

SKILTOOLS

SKILSAW, INC. 5033 Elston Ave., Chicago 30, Ill.

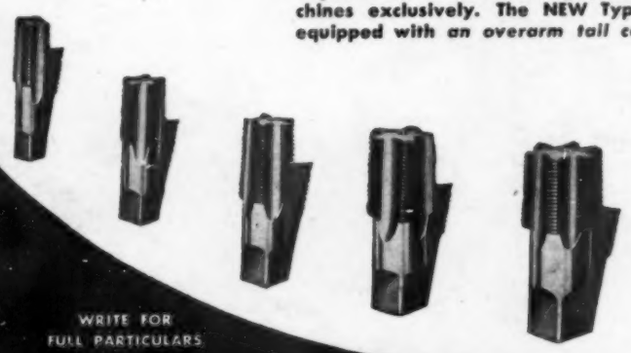
Factory Branches in Principal Cities

. . . A "REVOLUTION" IN MACHINING INDUSTRY . . .

TOUGH Threading jobs licked by COULTER TYPE "H" THREAD TAP MILLING MACHINE

NOW . . . comes a development that extends the capacity of this 'wonder' machine. COULTERS' are made to perform the most delicate threading operation with both speed and accuracy . . . 40 years of specialized experience, manufacturing precision machines exclusively. The NEW Type "H" is equipped with *an overarm tail center and large collet chuck*, holding the work rigidly so *ONLY ONE REVOLUTION OF THE TAP* is necessary.

Any number of FLUTES, eccentric or concentric relief straight or taper can be produced. Pipe taps from ⅛" to 1½" and straight taps from ¼" to 1½"



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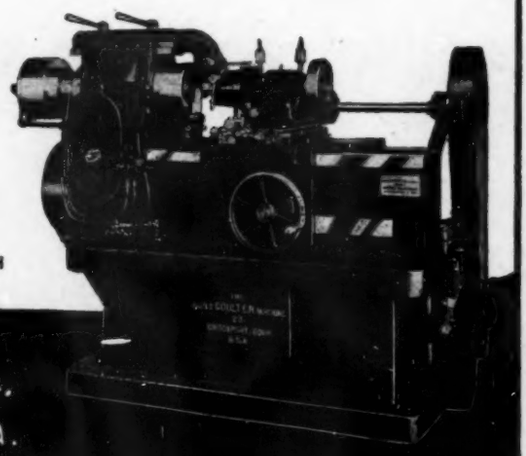
PRODUCTION MACHINES SINCE 1896



TYPE H

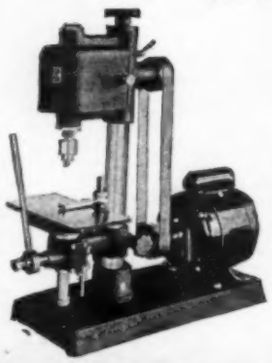
The James **COULTER** *Machine Co.*

BRIDGEPORT • CONNECTICUT • U.S.A.

Banish the spectre! Install the Hamilton Super Sensitive Tapping Machine, a specialist in precision tapping of small holes (from the smallest and finest tap to 10-32 inclusive).

Patented power transmission and adjustable stops permit tapping of blind holes to the very bottom without tap breakage. Spindle idles in reverse while tap is being centered. Pressure to feed lever changes spindle rotation. Release of pressure reverses and withdraws tap.

Get complete description and specifications. Write for Bulletin T-47.



THE *Hamilton* TOOL COMPANY

830 SO. NINTH STREET • HAMILTON • OHIO • U.S.A.

These are the ***NEW***

DUBLIFE Plug Gages with

COLORED *Plastic* (INSULATING) COLLETS

Colored Collets identify plug instantly. Weight is reduced, Plugs securely locked without marring or scratching plugs as with metal collets.

New Light Weight Handle with these collets.

DUBLIFE

REVERSIBLE

In one and same balanced handle, 2 "GO" and 2 "NO GO" Plugs. Tolerances to .00002. Reverse either plug when wear shows and you have a new, fresh gage. Time saving! Gage saving! Money saving! It is to your advantage to know about DUBLIFE GAGES with colored plastic collets and light weight handles. Send for complete catalog showing DUBLIFE and A. G. Design Gages.

Ask for Catalog "G"

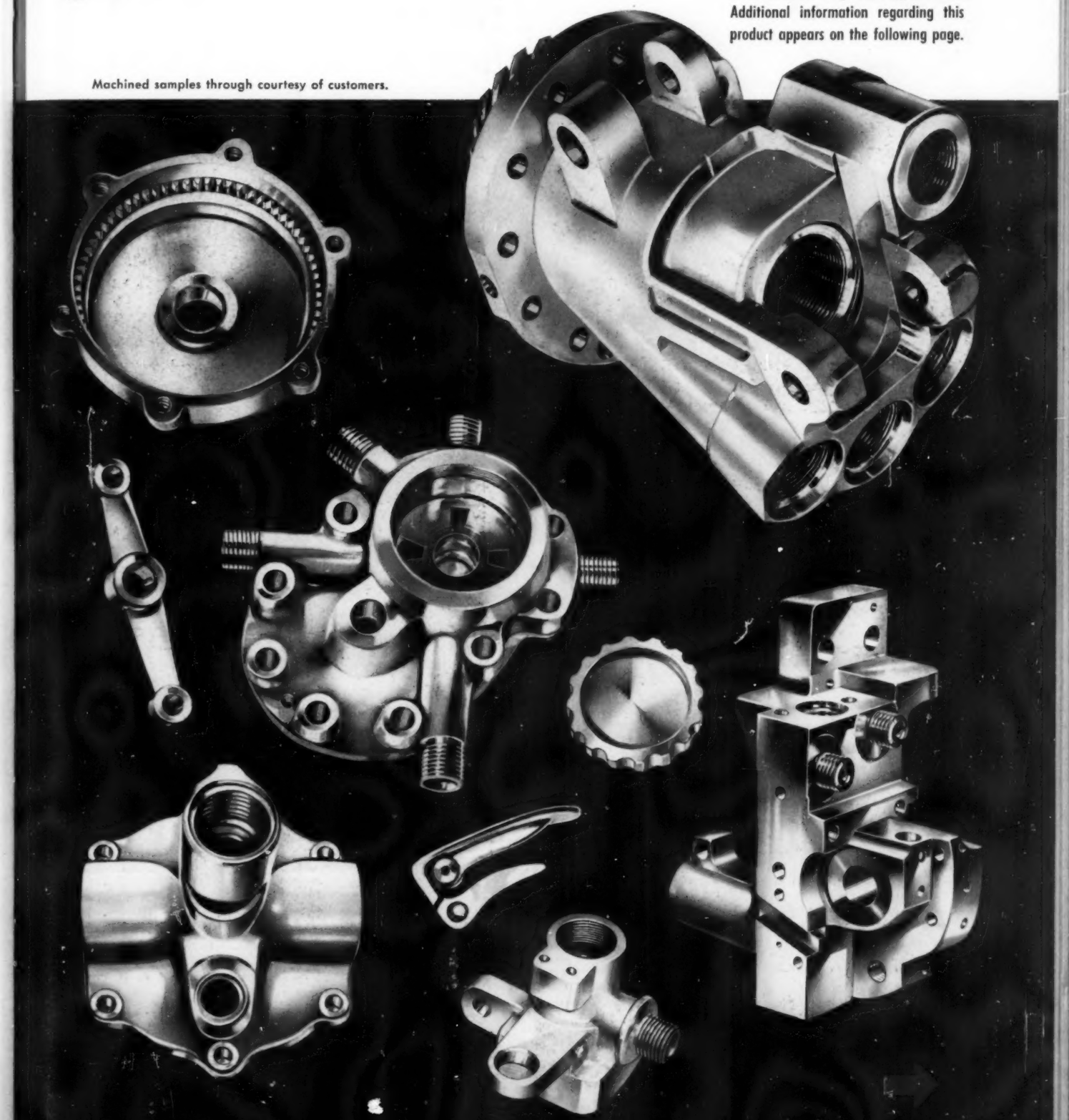
UNITED PRECISION PRODUCTS CO.

SHABBONA, ILLINOIS

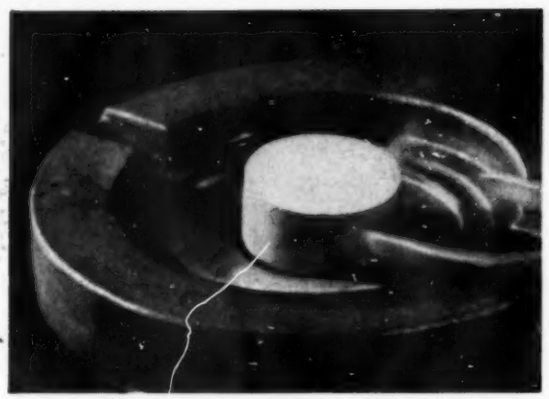
Anaconda HOT PRESSED FORGINGS
made by The American Brass Company

Illustrating the almost unlimited design possibilities in producing complicated or intricate parts of wrought Copper, Brass, Bronze or Special Copper Alloys. Additional information regarding this product appears on the following page.

Machined samples through courtesy of customers.



Here's how Anaconda Hot Pressed Forgings are made



1
a heated copper-alloy blank is centered in the die . . .

2
the dies close—with hundreds of tons of pressure . . .

3
and presto! — the metal is wrought into a semi-finished shape.

Of course, it isn't quite that simple. There are such matters as alloy composition, forging temperature, die design, trimming, piercing or sizing — but these are problems that we take care of.

and here's how they improve the product, reduce the cost

Anaconda Hot Pressed Forgings have twice the strength of sand castings—without the sand that causes needless tool wear. Absence of internal defects and a uniform, dense grain structure make them gas, air and watertight—able to withstand high pressures. Consistently accurate in dimension, they have a smooth, fine-textured surface and machine readily. Available in Copper, Brass, Bronze and Special Copper Alloys.

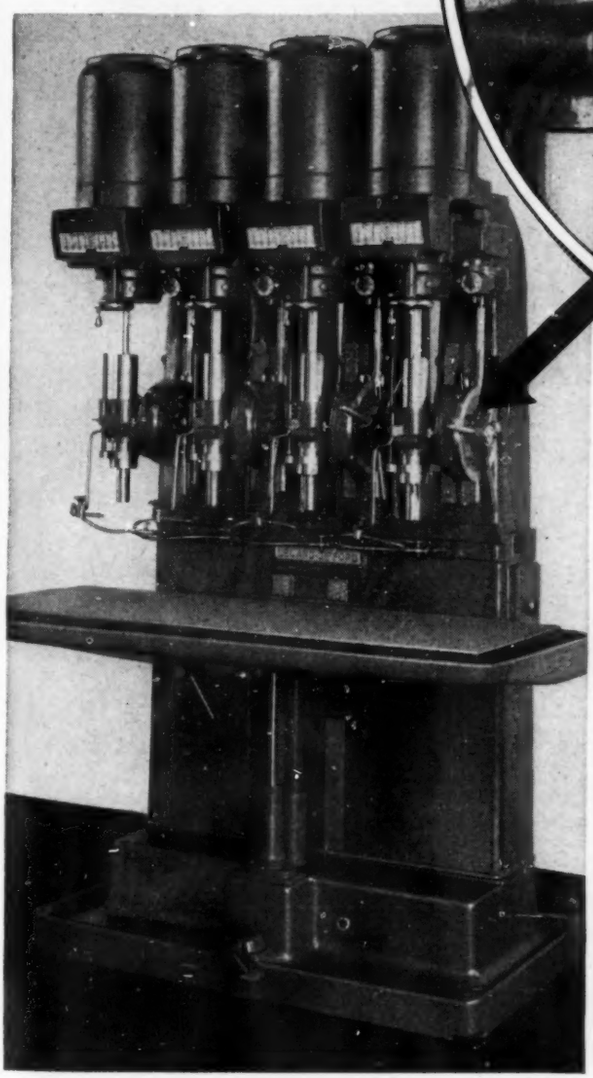
For typical examples of Anaconda Hot Pressed Forgings, see the preceding page. Inquiries regarding specific metallurgical, design, cost or production information will be given prompt attention. 45161

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

ANACONDA *Anaconda Hot Pressed Forgings*

LELAND GIFFORD *POWER FEED*



This POWER FEED

is engaged by the natural movement of starting the drill into the work with the feed lever, and may be disengaged by the reverse movement. A positive adjustable depth stop is provided. A ring graduated in 64ths of an inch makes setting easy.

For Reaming when a Positive Engagement is necessary before the tool strikes the work, the power feed may be furnished with Hand Engagement which starts the feed with a squeeze of the hand. When the machine is to be used intermittently for hand feed operation a **Locking Pin** is included to make the power feed inoperative.

LELAND-GIFFORD

WORCESTER 1, MASSACHUSETTS, U. S. A.

Goss & De Leeuw

THE WORLD'S FINEST MULTIPLE SPINDLE

Chucking Machines

GOSS & DE LEEUW MACHINE CO.

New Britain, Conn.

PRODUCTION LINE RIVETING CAN BE A QUIET OPERATION

If riveting is an essential operation on your production line, let a Linley handle the job with efficiency . . . minus the noise! Through vertical travel of the spindle, twin rollers contact the rivet end and uniform heads are shaped . . . not hammered.

Six standard machines are available for floor installation with capacities up to 3/8" diameters. Horizontal or direct connected vertical motor drives. Where there are space limitations, bench models can be furnished.

For riveting machines that are designed and built for long service—even for the tough jobs—look to Linley.

Write for detailed Bulletin

LINLEY BROTHERS COMPANY
864 STATE ST. EXTENSION
BRIDGEPORT 1, CONNECTICUT

POWER HACK SAW

LOW PRICED
SELF-CONTAINED
PORTABLE
STURDY
READY TO WORK
ECONOMICAL
EXPORT DEPT.
1111 SO. FERRY BLD'G.
NEW YORK 4, N.Y.

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MILLER-KNUTH MFG. CO. OMAHA, NEB.

HARDNESS TESTER

The *Scleroscope* is the only hardness tester that takes in the entire range from the softest to the hardest metals without any adjustments.

MODEL D-1 DIAL TYPE

Write for Circular!

THE SHORE INSTRUMENT & MANUFACTURING CO., INC.

9025 VAN WYCK AVENUE
JAMAICA, NEW YORK

TELEPHONE: JAMAICA 6-4090

Combine Operations

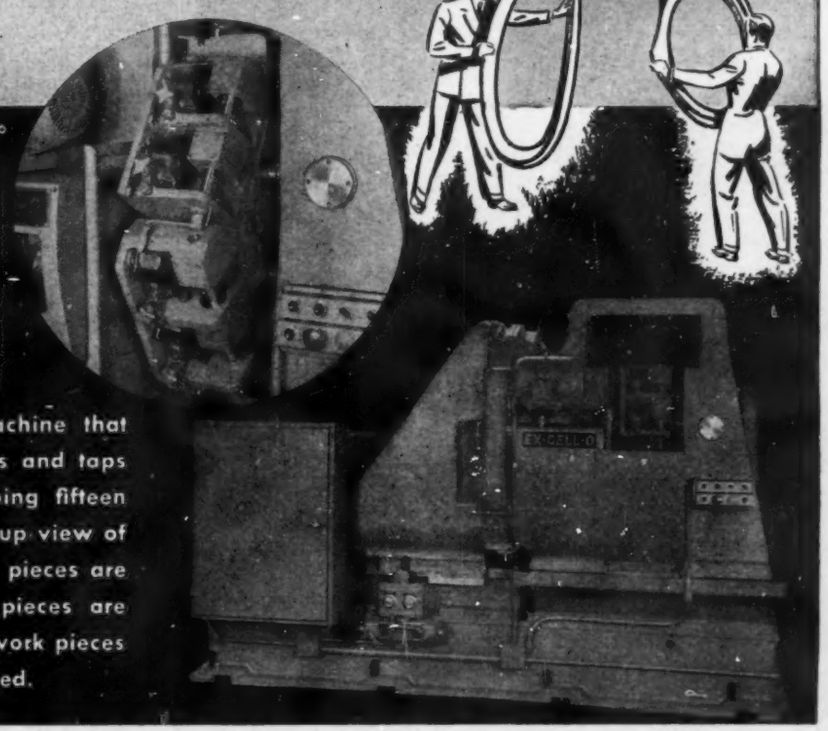
AND CUT PRODUCTION COSTS

Consider an Ex-Cell-O Special-Purpose Machine; It May Prove a Profitable Investment for You!

In many instances, despite high labor costs, production costs can be held down by combining operations and letting automatic machines do more of the work. Combining operations requires less man-hours, less floor space, less handling of parts, and also assures accurate work . . . as the parts are located and clamped only once the different operations are easily held in correct dimensional relationship. Many industries are combining diversified machining operations on Ex-Cell-O Special-Purpose Machines and finding that it pays off in more parts per hour and lower unit cost.

XLO
EX-CELL-O for PRECISION

47-22



Machine tools are the extension of a man's ability to produce more . . . with less effort . . . and with greater personal gain!

To right: Ex-Cell-O Special-Purpose Machine that drills, countersinks, reams, counterbores and taps malleable iron steering [illegible] parts, doing fifteen operations on each part. *In circle:* Close-up view of fixture with guards removed. Two work pieces are clamped at each station. New work pieces are loaded in the upper front station while work pieces at the lower front are being tapped.

EX-CELL-O CORPORATION

DETROIT 6
MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • CONTINENTAL CUTTING TOOLS • MISCELLANEOUS PRODUCTION PARTS
FUEL INJECTION EQUIPMENT • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • DAIRY EQUIPMENT

Hammond of KALAMAZOO

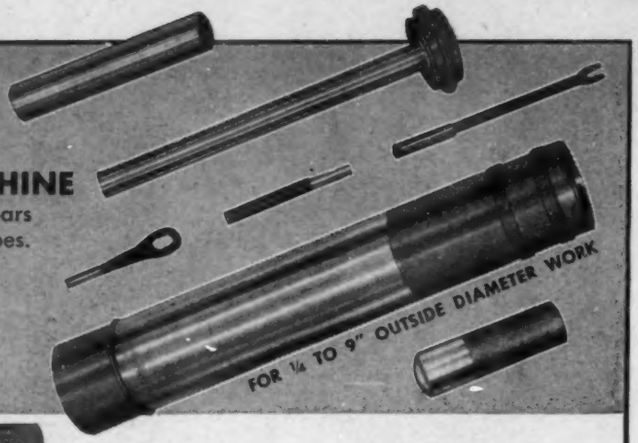
OD-9 CYLINDRICAL FINISHING MACHINE

For Faster, Better Finishing of Tubes, Rods, Bars and a Wide Variety of Cylindrical Shapes.

CENTERLESS No holding or chucking.

VERSATILE Uses abrasive belts or polishing and buffing wheels.

FAST UP to 30' per minute.



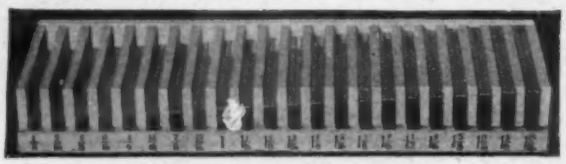
For plunge cut or through feed. Idler roll fixtures as shown for long work. Send samples for detailed engineering report . . . no obligation.

Hammond Machinery Builders INC.

1618 DOUGLAS AVENUE • KALAMAZOO 54, MICHIGAN

ANTON PARALLELS

INCREASE PRODUCTION IMPROVE QUALITY USE ANTON PARALLELS ANTON PARALLELS FILL A LONG-FELT NEED—Permanently straight and accurate, yet priced for general machine shop use. All fully guaranteed to be within the limits specified. Maximum size tolerance .001 inch on ground sides. Maximum variation in parallelism and straightness within length, .0001. Rockwell "C" hardness 65 up.



Price per set includes a handy Wooden Container. Large Stock of Single Pairs also Available. All Prices are F.O.B. New York

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Famous for

- ACCURACY OF THREADS
- LOW CHASER COST
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Bulletins available: General Purpose Die Heads, Insert Chaser Die Head, Threading Machines.

See our Advt. on page 358 Jan. 16, '47 American Machinist

THE EASTERN MACHINE SCREW CORP., 20-40 Barclay St., New Haven, Conn.
Los Angeles: A. C. Behringer, 324 N. San Pedro St., San Francisco: Guy Reynolds, 464 Vernon St., Oakland, Canada: F. Barber Machinery Co., Toronto, Canada.

DAVIS KEYSEATER

This low cost machine will handle internal keyseating jobs up to 1¼ in.

Write for illustrated bulletin.

DAVIS KEYSEATER CO., 403 Exchange St., Rochester, N. Y.

CARLTON RADIAL DRILL

FEATURES: 1. Low Hung Drive to Spindle. 2. All Power Driven Parts Running in Oil. 3. Quiet Running at all Speeds. 4. Concentrated and Convenient Push-button Controls. 5. Constructed on Unit Principle.

THE CARLTON MACHINE TOOL COMPANY

CINCINNATI 25, OHIO, U. S. A.

Bridgeport

TURRET MILLING MACHINE

One of the reasons for the outstanding acceptance of this modern machine is its versatility. Designed for milling, drilling, boring and shaping *at all angles,* and without changing set-up, the "Bridgeport," in a single machine combines the functions of several single-purpose machines. Because of its ability to handle a wide range of operations quickly, economically and conveniently at a moderate investment cost, the "Bridgeport" pays high returns in modernization programs.

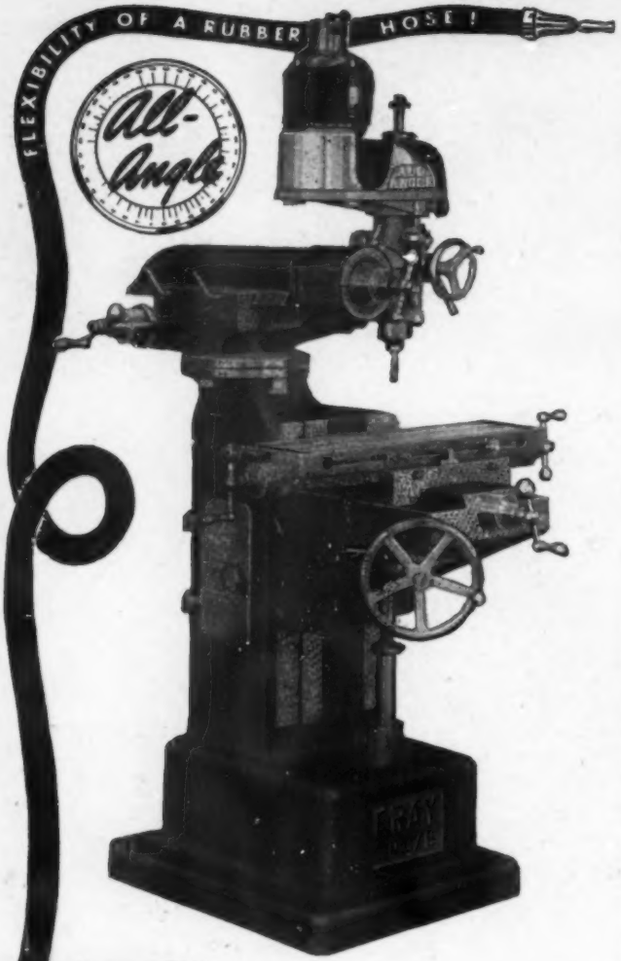
It will be to your advantage to explore the possibilities of the Bridgeport Turret Milling Machine on your work.

Specifications

Longitudinal Feed—20"
Cross Feed—9"
Vertical Feed of Knee—16"
Standard Table—9" x 32"
Special Tables up to 48" available; also longitudinal power feed
Weight with Shaping Unit—2000 lbs.

Ask for complete, detailed information.

THE Bridgeport **MACHINES, INC. BRIDGEPORT, CONN.**



Fray

PRECISION RAM TYPE NO. 7-B

VERTICAL UNIVERSAL

MILLING MACHINE

- Flexible
- Sturdy
- Universal
- Easy to operate
- One set up
- All angles quickly obtained

- Four Sizes
- Four Types
- Adaptable to all Milling Machines

For further information write Dept. C

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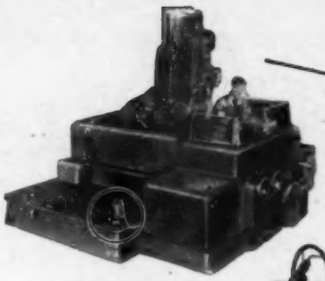

Pratt & Whitney 20" Gear Grinder in operation. Equipped with ¾ H.P. Model HL-2 Gusher Coolant Pump.

Kent - Owens #2-20 Hydraulic Milling Machine, equipped with 1/10 H.P. Model 2 - P3 - Short Gusher Coolant Pump.

LARGE OR SMALL

There's a . .

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COOLANT PUMP

for every metal cutting operation

There is a size and model Gusher Coolant Pump to fit your exact needs, from 1/10 to 2 H.P. up to 209 gallons-per-minute capacity.

Your coolant system worries are over when a Ruthman Gusher Coolant Pump is installed on your machine.

Write for Catalog 10-A

THE RUTHMAN MACHINERY CO.

1818 Reading Road Cincinnati, Ohio

Hammond of KALAMAZOO

BACKSTANDS

For converting standard Polishing Lathes into *high production* abrasive belt grinder-polisher units. Lifetime Machine tool construction.

HAMMOND "VRO" Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe with two No. 3 Backstands.

MODEL No. 3 SHOWN

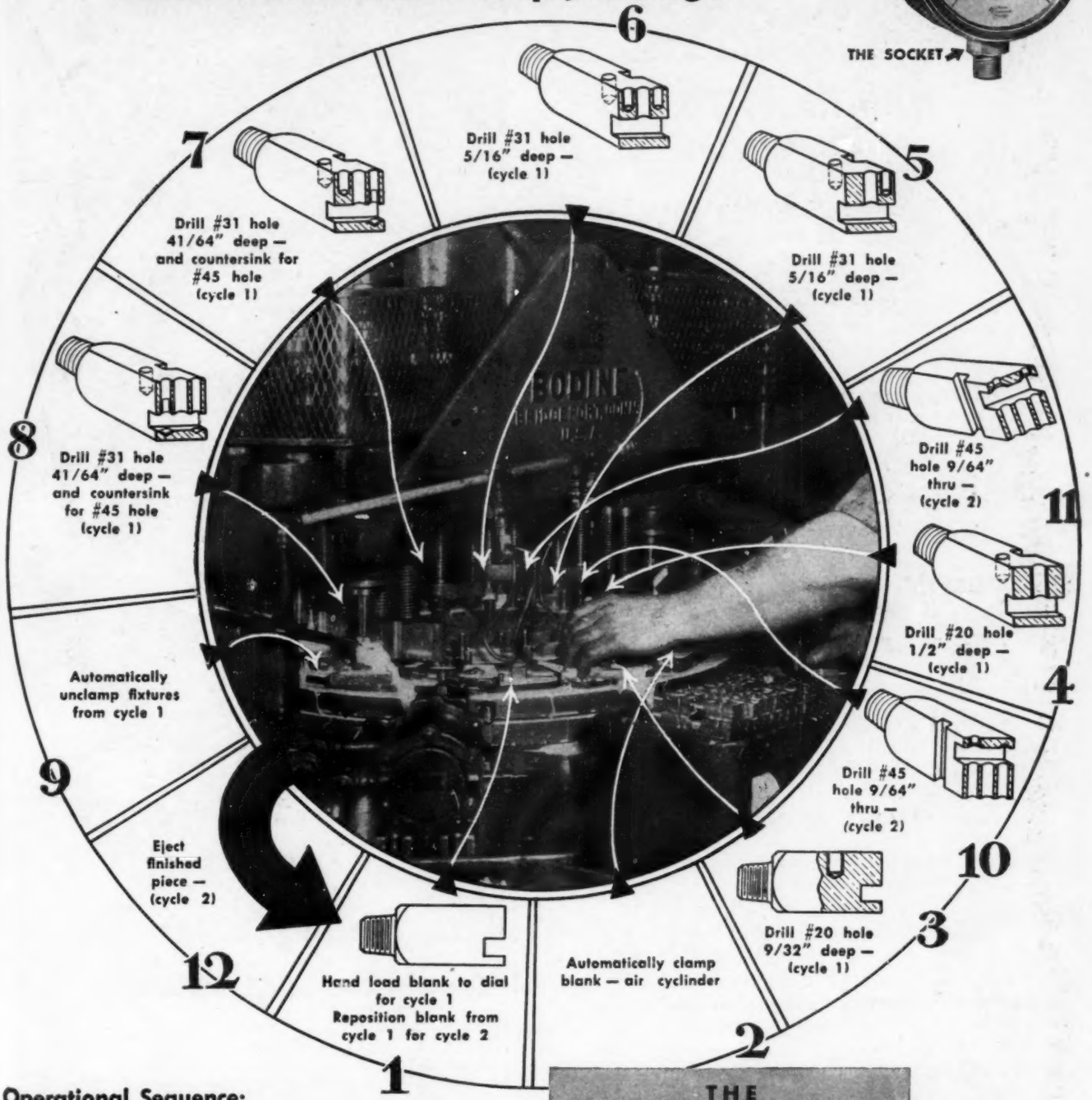
Write for new Catalog No. 55 covering Backstands, Polishing Lathes and many types of finishing machines including Automatics.

Hammond Machinery Builders

1618 DOUGLAS AVENUE • KALAMAZOO 54, MICHIGAN

Bodine...CASE HISTORY No. 19

Processing a Brass Gauge Socket at the Jas. P. Marsh Corp., Chicago


6
Drill #31 hole 5/16" deep — (cycle 1)
5
Drill #31 hole 5/16" deep — (cycle 1)
11
Drill #45 hole 9/64" thru — (cycle 2)
4
Drill #20 hole 1/2" deep — (cycle 1)
10
Drill #45 hole 9/64" thru — (cycle 2)
3
Drill #20 hole 9/32" deep — (cycle 1)
2
Automatically clamp blank — air cyclinder
1
Hand load blank to dial for cycle 1 Reposition blank from cycle 1 for cycle 2
12
Eject finished piece — (cycle 2)
9
Automatically unclamp fixtures from cycle 1
8
Drill #31 hole 41/64" deep — and countersink for #45 hole (cycle 1)
7
Drill #31 hole 41/64" deep — and countersink for #45 hole (cycle 1)

Operational Sequence:

This Bodine set-up employs 8 spindles. The part is repositioned in the dial for a second pass (cycle 2) under the spindles to complete all operations.

Production:

One piece is completed per stroke of the machine, 700 pieces per 50 minute hour . . . a total of 5600 operations. Maybe YOU can use a Bodine to reduce production costs.

THE
Bodine
CORPORATION
BRIDGEPORT 5, CONNECTICUT
AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

Quick-Versatile
ROTARY MILLING & INDEXING

with KNIGHT'S 20" ROTARY TABLE

A SINGLE SELF-CONTAINED MOTOR-DRIVEN UNIT

- Adapts any milling machine for power rotary milling and indexing work within a few moments.
- Setup time is virtually eliminated — just plug into nearest electric outlet for immediate operation. No other equipment or connections are required.
- Ample power is provided for almost any milling operation by a special geared-down motor.
- 18 feed changes for 1½" to 54" per minute make adjustment to any cutting speed simple and quick. An optional feed range from 3" to 108" is available.
- In addition to indexing and rotary milling, the usefulness of the Rotary Table is further widened by its adaptability to many other jobs where an automatic revolving fixture would save time and costly manhours.

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W. B. KNIGHT
MACHINERY COMPANY

KNIGHT VERSATILE MILLERS ACCURATE RIGID

MORE GOODS for MORE PEOPLE at LOWER COST

3920 WEST PINE BLVD. • ST. LOUIS 8, MISSOURI

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WHEREVER METAL IS BEING TURNED

Front and center in the ranks of metalworking equipment stand Axelson Heavy Duty Lathes . . . Outstanding in quality, accuracy and durability these lathes "have everything" to arm you for complete victory in any contest for metal working profits.

Call *any* Axelson Lathe out of line, as they move towards the machine shops of the world, and you will find a versatile, fast, accurate and time-saving machine for light or heavy work. Maintenance costs, too, are extremely low.

Axelson Lathes, of various lengths, are manufactured in 14, 16, 18, 20, 25 and 32-inch sizes.

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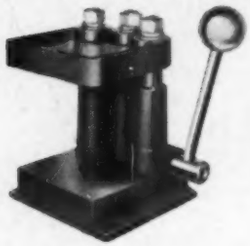
6160 S. Boyle Ave. (Box 98, Vernon Station), Los Angeles 11, Calif. • 50 Church St., New York City 7 • 3844 Walsh St., St. Louis, Mo.

AXELSON *Lathes*

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

DEPENDABLE FOR OVER A QUARTER CENTURY

"CONE-LOK" JIGS



The Woodworth "CONE-LOK" jig utilizes the full braking power of its perfectly mated male and female cones.

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• MECHANICAL SIMPLICITY • ADAPTABILITY
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★ CATALOG AND FULL SCALE TEMPLATES UPON REQUEST ★

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N. A. WOODWORTH CO., • SALES DIVISION
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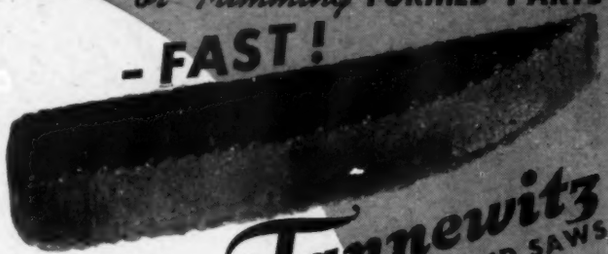
for Sawing METAL *as* HARD *as a* FILE
or Trimming FORMED PARTS
- FAST!



Actual photo of file friction sawn on Tannewitz High Speed Band Saw.

Tannewitz
HIGH SPEED BAND SAWS

Cost reductions that are downright amazing are effected in the cutting of an extremely wide variety of materials by friction sawing with TANNEWITZ HIGH SPEED BAND SAWS: flat sheets, hardened or soft steels, armor plate plastics, and many others. Formed aluminum parts can be trimmed without using a rest of any kind. Whatever your cutting problem, chances are it can be done faster and better with TANNEWITZ HIGH SPEED BAND SAWS. Write for booklet: "FRICTION SAWING."

THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICHIGAN

Save Hands Speed Production with—

LITTELL
Pres-Vac Safety Feeder

KEEP workmen's hands out of Danger Zone. Use PRES-VAC Safety Feeders to keep hands safe, improve quality and speed production. Pres-Vac acts on trigger-vacuum principle. Picks up—drops—material instantly. Uses compressed air, 10 to 45 lbs. pressure.

Littell makes a complete line of pressroom equipment, including: Reels, Roll, Dial and Magazine Feeds; Straighteners; Air-Blast Valves; Scrap Winders, etc. *Request Bulletins.*

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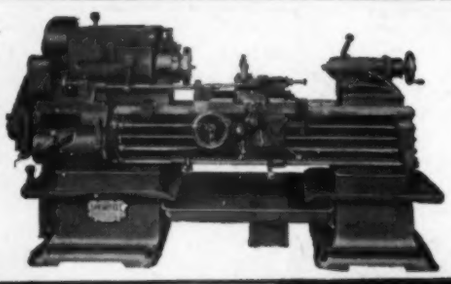
HARDNESS TESTER
Made Only by Wilson

• Development and improvement of "ROCKWELL" Hardness Testers over the years have made "ROCKWELL" scales the universal standard of hardness. A reading on the "ROCKWELL," the "ROCKWELL" Superficial or the "TUKON" Tester is the same in any language.

WILSON MECHANICAL INSTRUMENT CO., INC. ACCO
AN ASSOCIATE COMPANY OF AMERICAN CHAIN & CABLE COMPANY, INC
230-B PARK AVENUE, NEW YORK 17, N. Y.

SPRINGFIELD GEARED HEAD LATHES

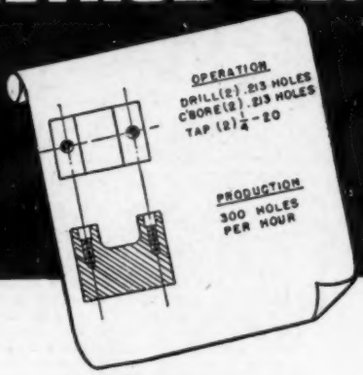


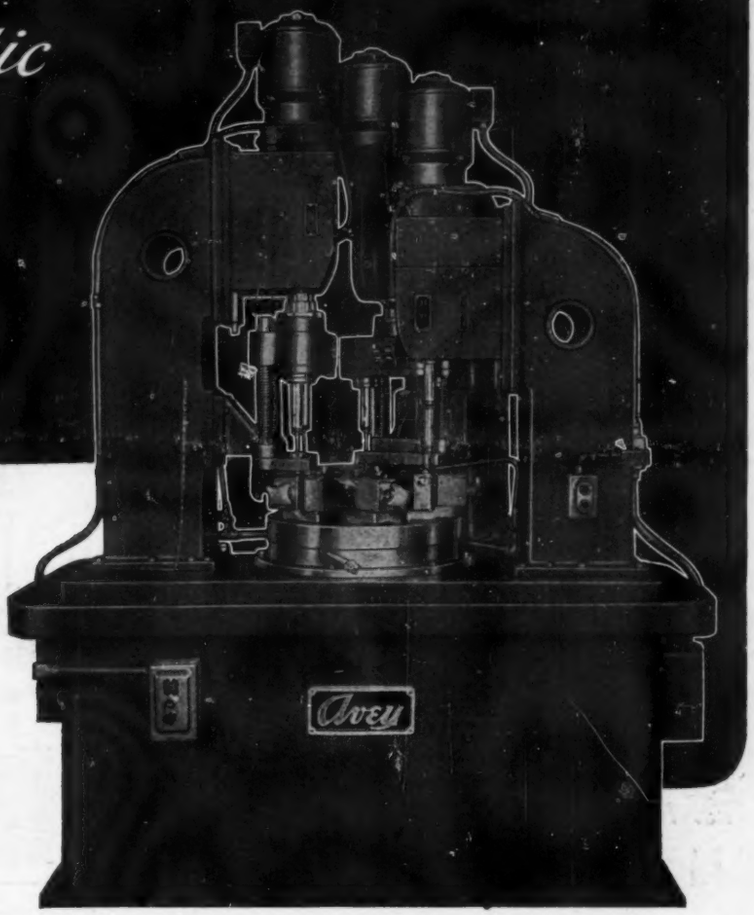
. . . versatile, efficient!

Springfield designs lathes to retain accuracy and speed over long periods of use. For quantity production or special use they're economical and extremely adaptable. Sizes available range from 14" to 30". *Write for descriptive bulletins, prices and deliveries.*

The SPRINGFIELD MACHINE TOOL COMPANY • • • SPRINGFIELD, OHIO, U.S.A.

Avey Automatic METHOD No. 4





THE Avey CAM FEED UNIT

No. 1 Size—1/2" capacity in cast iron.
No. 2 Size—7/8" capacity in cast iron.

designed for multiple operation on individual holes--drilling, counterboring (reaming or redrilling) and tapping at one clamping of work

THE AVEY DRILLING MACHINE CO.
CINCINNATI • OHIO • U. S. A.

Send for Engineering Bulletin 645

Accelerated production obtainable by free loading time and multiple operations on several parts simultaneously in normal time required for one operation.

Method No. 4. Lower cost per part—higher production per capital investment—greater accuracy by semi-skilled operators delivering high quality production speedily, accurately, efficiently with a minimum of supervision.

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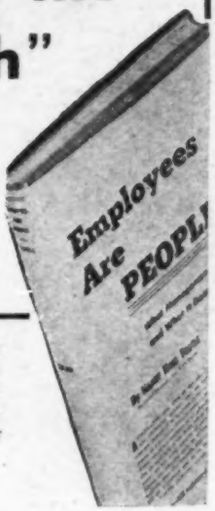
Represents High Standing in NAME-PRODUCT-POLICY

Avey DRILLING MACHINES
CINCINNATI - OHIO

How much is the "human touch" worth . . .

in organizing and directing your personnel activities?



YOU don't have to be a magician to spot the difference between a company with good morale and one with discontented workers—or a statistician to estimate which organization has bigger output, greater returns per worker.

Now, this plain-talking book shows you the actual methods which make all the difference.

1. It offers specific help in organizing and directing your personnel department and the whole broad range of your personnel activities, first, to set up, and then to maintain healthy conditions in which workers operate at their best.

2. Chapters cover the entire field of personnel administration, in terms of human relationships, to show how a well-organized personnel unit can be the deciding factor in company success.

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What Management Owes Them and What It Does for Them

By HARRY KING TOOTLE

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Gives successful methods to help you in—

- hiring the right people
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- fitting the employee to the job
- dealing with personal employee problems
- training the worker
- building good morale

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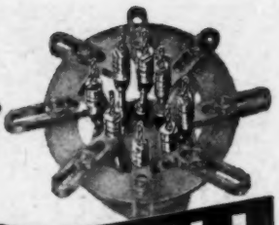

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DRILL UP TO 6 or 8 HOLES AT ONE STROKE IN *ANY* PATTERN WITH MULTI-DRILL

Fits ANY Drill Press

The 8-spindle unit in the MULTI-DRILL line brings your single spindle tools even greater production capacity and wider operating range. You can drill up to 8 holes at one stroke in *any* hole pattern on or within a 9" circle . . . ¼" center distances . . . drill sizes 1-32" to 3-8". (Special adaptations available.) All the features which make MULTI-DRILLS preferred tools are built in . . . fast, easy positioning of locating arms . . . heavy duty, long-life block-type universal joints . . . "Oilite" lifetime bearings . . . precision collet spindle assemblies and rugged construction throughout assure long trouble-free service. The 6-Spindle MULTI-DRILL handles any hole pattern on or within 5" circles—½" min. centers.

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Telephone SACramento 4545

LUERS Patented Cutting Off Tool Holders
Patented Cutting Off Blades

ONLY the PATENTED construction of LUERS cutting off BLADES permits normal expansion of bursting chips — MEANS MAXIMUM CUTTING EFFICIENCY.

Manufactured By

J. Milton Luers — 12 Pine St. — Mt. Clemens, Mich.

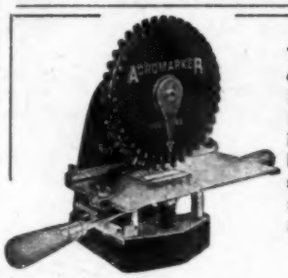
Produced under License Issued by John Milton Luers Patents Inc.

Original System of Inserted Blade

OK *Milling and Boring Tools*

See Issue January 16th, 1947 American Machinist

THE OK TOOL CO., INC.
SHELTON, CONN.



The ACROMARKER is a remarkably easy-to-operate marking machine offering faster, more accurate marking than heretofore possible. Widely used in industry, this model weighs only 30 lbs. It stamps letters and figures in straight or curved lines. With it unskilled help can do the work of skilled men faster and accurately.

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The ACROMARK Company

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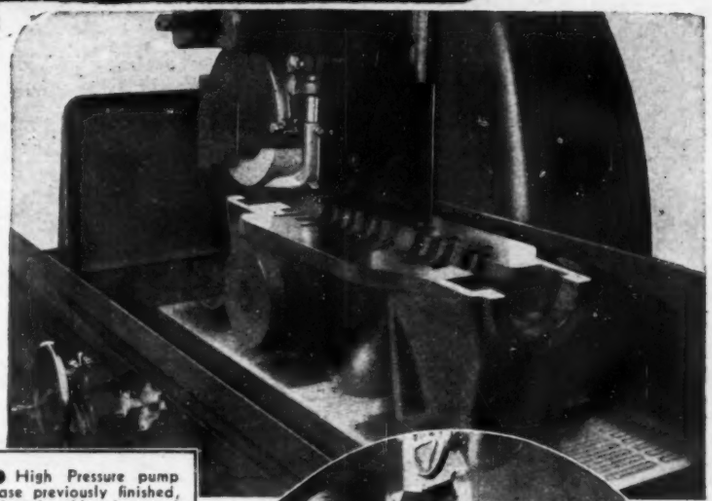
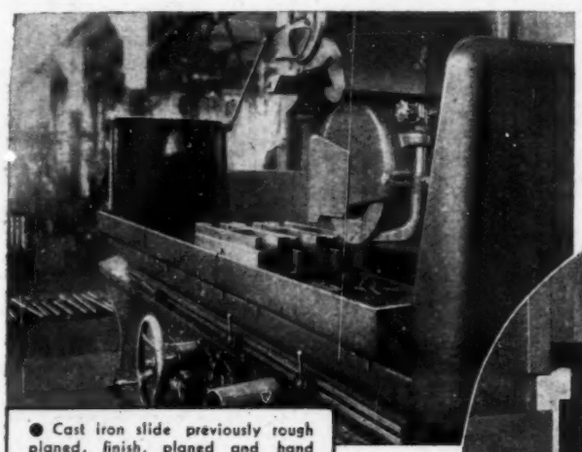
MATTISON GRINDER
Cuts time up to 75%
ON JOBS PREVIOUSLY HAND SCRAPED

Examples: Time on pump case reduced from 40 hours to 4 hours . . . . . Time cut from 12 hours to 3½ hours on slide castings . . . . . Yearly saving on Housings — 22% the cost of machine, etc.

When added together, time savings like this make a big difference in manufacturing cost. To see what Mattison High-Powered, Precision Surface Grinders can do on your work, send us blue prints for production estimates.

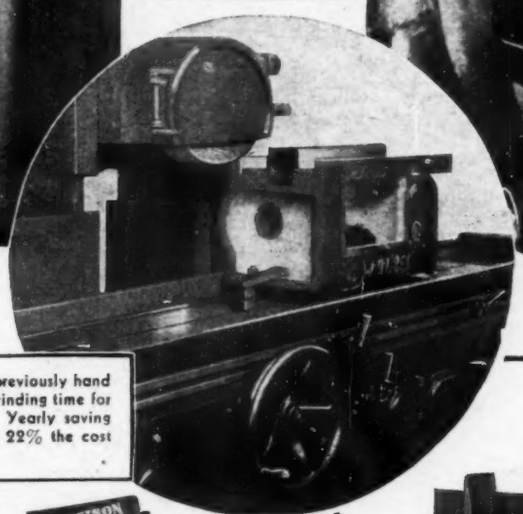


● High Pressure pump case previously finished, planed and hand scraped in from 40 to 48 hours — Now the Mattison Grinder has made these operations unnecessary, reduced time to 4 hours and case comes through with a fine finish and accurate to within .0003".



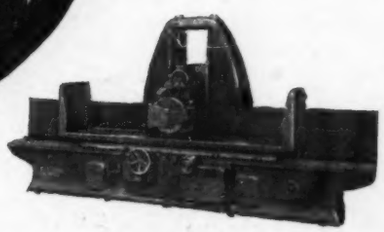
● Cast iron slide previously rough planed, finish, planed and hand scraped — NOW GROUND on Mattison Grinder (6 pieces per set-up) at an 80% savings in time. Finish planing and scraping operations eliminated.

● Cast iron frame previously hand scraped, NOW GROUND top and bottom of casting, shoulder and inside surfaces. 75% time saving.



● Cast iron Housing previously hand scraped in 8 hours. Grinding time for housing is 2.5 hours. Yearly saving on this job alone was 22% the cost of machine.

Write for Free Set-up Book containing further examples, showing how others have reduced time and cut costs with Mattison Grinders.



Mattison High Powered Precision Surface Grinder. Table Sizes: 12" to 36" wide, 36" to 192" long.

MATTISON MACHINE WORKS

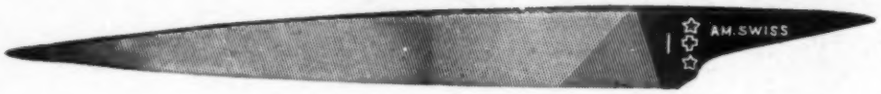
ROCKFORD · ILLINOIS

Do You Know...

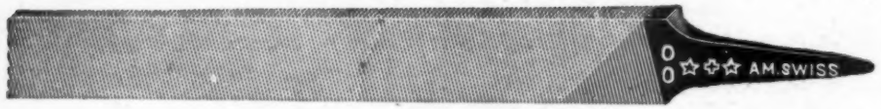
that you can file the

most intricate surface

with an "AMERICAN SWISS"



Swiss-Pattern File.



For 45 years, "American Swiss" has been making precision files for the jobs that ordinary files can't handle. The 3000 different shapes, sizes and cuts of "American Swiss" Swiss-Pattern files provides exactly the right selection for any finishing filing work, and these uniformly hard accurately made tools assure best results in least time.

AS-134

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American Swiss File & Tool Co., Elizabeth 1, N. J.

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American Swiss

SWISS PATTERN FILES

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"SOCKET SCREW" KIT
with interchangeable bits

For men who like to have a complete supply of tools, yet dislike bulk and confusion, the Hallowell "Socket Screw" Kits are the answer. Their hollow, durable plastic handles hold interchangeable *steel* bits for most all purposes . . . Phillips, Hex and Flat. They each have a swivel bit-chuck, which locks securely in five positions.

The "Socket Screw" Kit comes in 2 sizes: small #25 Kit; and the large #50 Kit.

Other Hallowell Kits: "Socket Wrench"; "Auto"; "Home".

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Kits: Patents Pending

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Increase Man-Hour Output

Produce MORE *Products in* METALS . PLASTICS . WOOD *WITH* FEWER, SIMPLER OPERATIONS

Brightboy gives you A MODERN FINISHING MEDIUM — RUBBER AND ABRASIVE IN COMBINATION — which achieves work-saving results by simultaneous BURRING, FINISHING and POLISHING.

The Brightboy Catalog-Manual gives you PRODUCTION-LINE EXAMPLES, PRODUCTION-METHOD RECOMMENDATIONS, COST-SAVING ILLUSTRATIONS — all vitally important in relation to today's demand for greater output and fewer work-operations.

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WELDON ROBERTS RUBBER CO. **Newark 7, N. J.**

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Weldon Roberts Rubber Co.,
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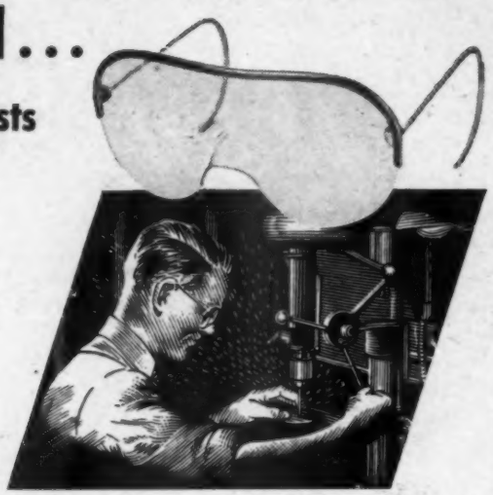
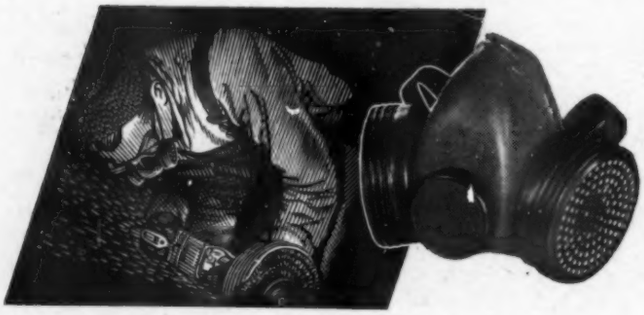
to Change Accident Costs into Safety Savings



PROTECTION IN 9/10 OF AN OUNCE . . . Day long comfort with the Feather Spec*. Large, clear or WILLSON Tru-Hue green, plastic lens gives unobstructed vision.

MOLDED TO FIT A THOUSAND EYES . . . Mirror-smooth rolled edges of the plastic eye cups conform to the contours of the eye cavities for snug, comfortable fit on hazardous jobs. With Super-Tough* lenses.



ALL 'ROUND PROTECTION—ALL 'ROUND COMFORT . . . Metal fumes; chromic acid mists; all dusts—excluded by dual, easy breathing filters and snug fitting facepiece.

For complete information on these products and their application, as well as many more eye and respiratory protective devices, get in touch with your nearest Willson distributor or write us direct.

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GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

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PRODUCTS INCORPORATED

READING, PA., U.S.A. Established 1870

235 WASHINGTON STREET, READING, PA., U.S.A.

The Lyon

INTERNAL GROOVING TOOL

Its versatility saves costly preparation time—provides precision grooving of single or multiple grooves at a production rate—plus economy of set-up time—and low initial cost. The LYON has been designed for making internal grooves to tolerances of .001" using any drill press, turret lathe, radial drill or automatic equipment.

By changing only bushings and cutters within the tool model range, you have at your command a wide variety of bore sizes and shapes. A simple adjustment regulates location and depth of groove. Work cannot be scratched or marred because the head of the tool does not turn when the cutter operates.

Our Engineering Department will welcome the opportunity of discussing any grooving problem without obligation.

LYON MACHINE CO., WORCESTER 3, MASS.

PINES *Automatic*

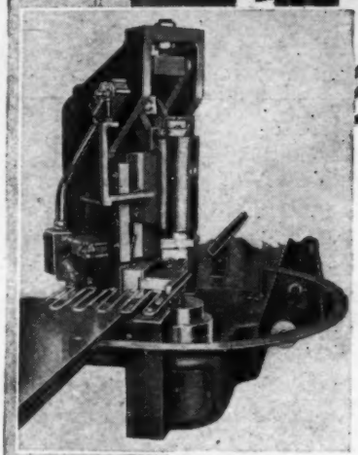
HIGH PRODUCTION

BENDERS

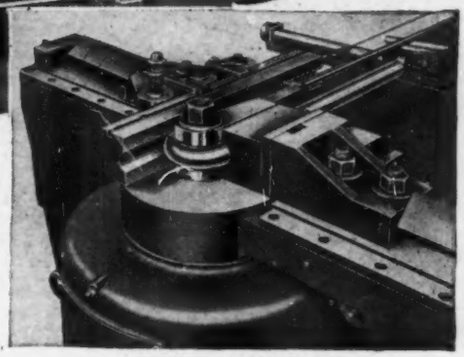
for Air Conditioning, Refrigeration and Sanitation Equipment

Push Button Control on all PINES Machines

FOR BOTH FERROUS AND NON-FERROUS METALS



Special Bending Head for Serpentine Coils

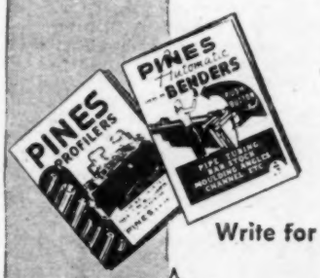


Precision, Wrinkle-Free Bending of Sink Traps

PINES HYDRAULIC BENDERS are built in 6 sizes for high speed bending of pipe, round and square tubing, angles, channels, extrusions and bars.

PINES BENDERS include many exclusive features such as automatic hydraulic angle-of-bend selector, mandrel rod stops, automatic feed cylinder, table and automatic solenoid-operated stop pin for supporting tube and determining position of bend.

PRODUCTION SPEEDS OF TYPICAL INSTALLATIONS: 1½" Brass Sink Traps—300 to 400 Bends per Hour. Serpentine Evaporator or Condenser Coils—600 to 1200 Bends per Hour.



Write for Catalogs

PINES AUTOMATIC PROFILER for chamfering, end facing, tapping, threading and boring tubing, pipe, and round bars at high production speeds.

PINES ENGINEERING CO., INC.

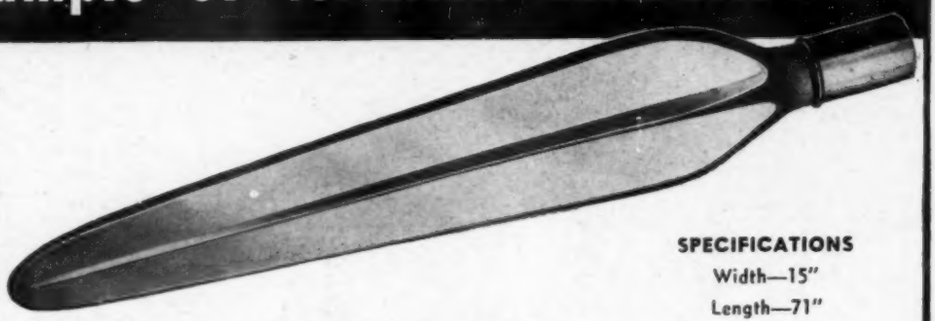
675 WALNUT STREET • AURORA, ILLINOIS • Phone Aurora 2-7608

SPECIALISTS IN TUBE FABRICATING EQUIPMENT

Another Example of WALKER LEADERSHIP

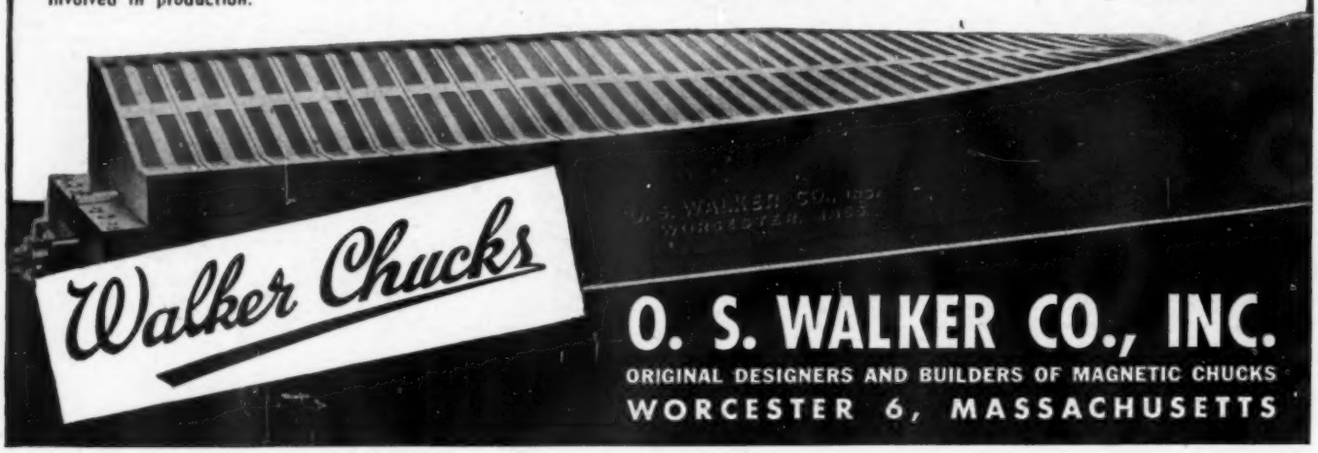
Magnetic holding of the part shown here is achieved in a chuck having sectional auxiliary top plates which are interchangeable. A substantial reduction in production cost along with increased production are being realized.

This magnetic chuck—specially designed and built by WALKER for holding aeroplane propellers during planing and milling operations—is an outstanding example of the way WALKER meets unusual conditions involved in production.



Walker Engineers—magnetic chuck pioneers—are prepared to assist you with your parts' holding problems.

SPECIFICATIONS
Width—15"
Length—71"
Height—11"
Weight—3300 lbs.



Walker Chucks

O. S. WALKER CO., INC.

ORIGINAL DESIGNERS AND BUILDERS OF MAGNETIC CHUCKS
WORCESTER 6, MASSACHUSETTS

ERRINGTON MECHANICAL LABORATORY

STAPLETON, STATEN ISLAND 4, N. Y.

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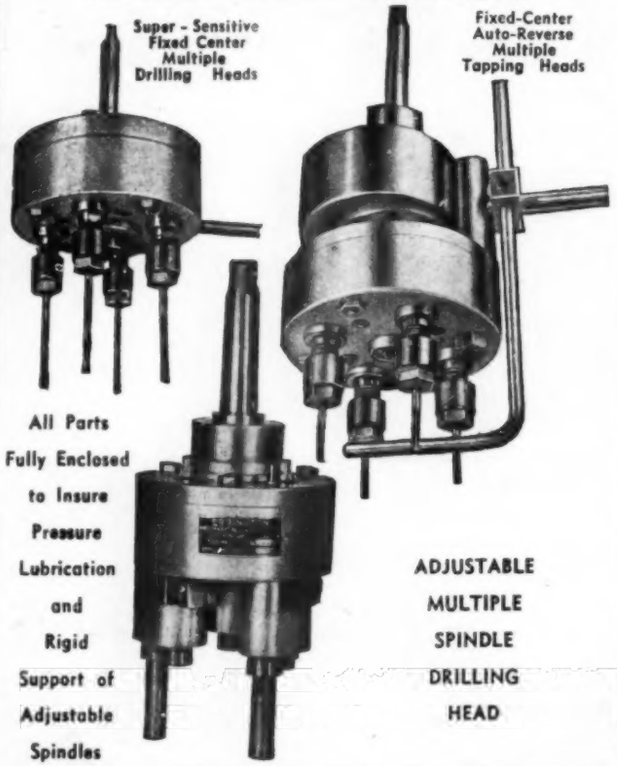
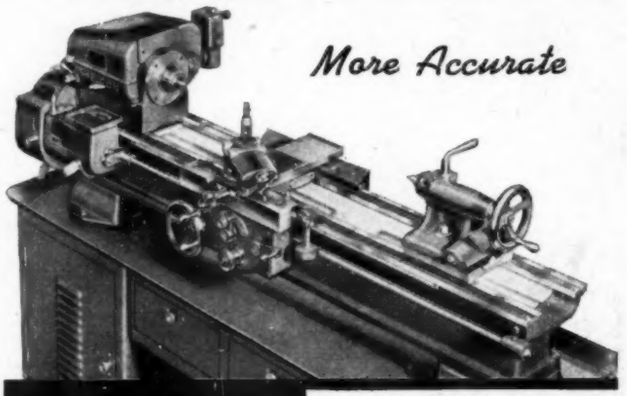
Super - Sensitive Fixed Center Multiple Drilling Heads

Fixed-Center Auto-Reverse Multiple Tapping Heads



All Parts Fully Enclosed to Insure Pressure Lubrication and Rigid Support of Adjustable Spindles

ADJUSTABLE MULTIPLE SPINDLE DRILLING HEAD



More Accurate

New SHELDON
TRB-S56 Precision Lathes

There is a degree of accuracy built into the new $1000.00 Sheldon TRB-S56 Precision Lathe heretofore found only in a few of even the most costly lathes. For example, spindle bearings are "Zero Precision," the very finest, closest tolerance tapered roller bearing manufactured. The heavily strutted, 1-piece bed has 2 V-ways and 2-flat ways ground on special bed grinder and held to the closest tolerance of lateral and parallel alignment. The lead screws are milled on the most accurate special lead screw milling machine.

In the Sheldon TRB-S56 modern engineering, extensive tooling combined with the finest special machinery—a modern machine tool plant with modern equipment, modern manufacturing methods—give this small (11¼" swing, 1" collet capacity, 56" bed, 8 speed—50 to 1350 r.p.m.), convenient, moderate priced lathe, the permanent accuracy and features, heretofore found only in more cumbersome and costly lathes.

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SHELDON MACHINE CO. Inc.
4234 NO. KNOX AVENUE, CHICAGO 41, ILL., U. S. A.

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"IT HOLDS SIZE"
SAFETY FILM
REGISTERED U. S. PATENT OFFICE

DINOGRAPHIC FILM has a Vinyl Copolymer Plastic Base which has the unique property of accurately holding size.

It possesses all of the desirable qualities of film, plus the size accuracy of glass plates.

DINOGRAPHIC FILM gives precision register, and sharp, black, open lines.

Originals or duplicates can be used directly on the comparator. Standard thickness .010.

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OTHER DI-NOC registered Trade Mark photographic products are: DINOBASE, DINOLOFT, DINOREFLEX, DINOBLUELINE and DINOCLOTH

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Photographic Division
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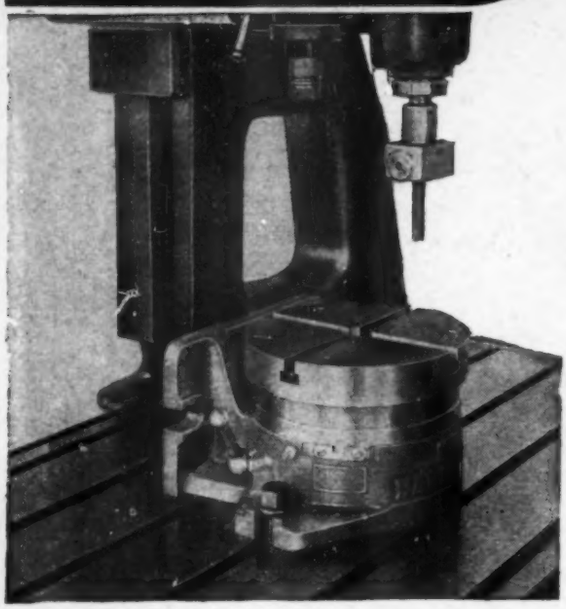
The HARTFORD SUPER-SPACER



Highly accurate and convenient for use in jig boring . . . . .

Many shops have availed themselves of the speed, convenience and accuracy of the Super-Spacer for a wide variety of set-ups on milling machines, drills, planers and slotters. Adaptability of the spacing device is almost universal and in all cases it can be depended on for accuracy in indexing. Super-Spacer Mask Plates provide for fool-proof indexing and thereby eliminate all possibility of error even in the hands of inexperienced operators.

Accuracy of the Hartford Super-Spacer makes it highly convenient for use on jig-boring operations. Supplementing its inherent precision is the facility with which a face plate may be attached and thereby provide precise location of work. The Hartford Super-Spacer is shown here equipped in this manner for jig-boring.

Get full details—NOW!

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HARTFORD 5, CONN.

Producing More Wire at Less Cost

Extending Die Life with Oakite CrysCoat Process

BY treating ferrous rods and wire with a non-hygroscopic, ductile, crystalline coating, the Oakite CrysCoat Process adsorbs and retains die lubricants. In addition, the Oakite CrysCoat Process combines chemically with surfaces treated to provide *additional* lubrication.

Among the proved advantages resulting from the use of the Oakite CrysCoat Process are increased production through less frequent changing of dies; longer die life; uniformly excellent wire appearance; retardation of rust. Complete details gladly sent on letterhead request. Send TODAY to Oakite Products, Inc., 24 Thames St., New York 6, N. Y.

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For cutting internal keyways, slots or splines 1/16" to 4" wide and up to 60" long. Fast—Accurate—Flexible. Write for particulars and catalog on machine for your work.

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Cut Production Time
WITH
NICHOLSON EXPANDING MANDRELS

Set of 19 does work of 209 solid arbors, thus saving the time lost in making or looking for them. For all bores 1" to 7". Hardened tool steel. Sold singly or in sets. Bulletin 1043.

Other Products: Steam Traps, Control Valves, Arbor Presses, etc.

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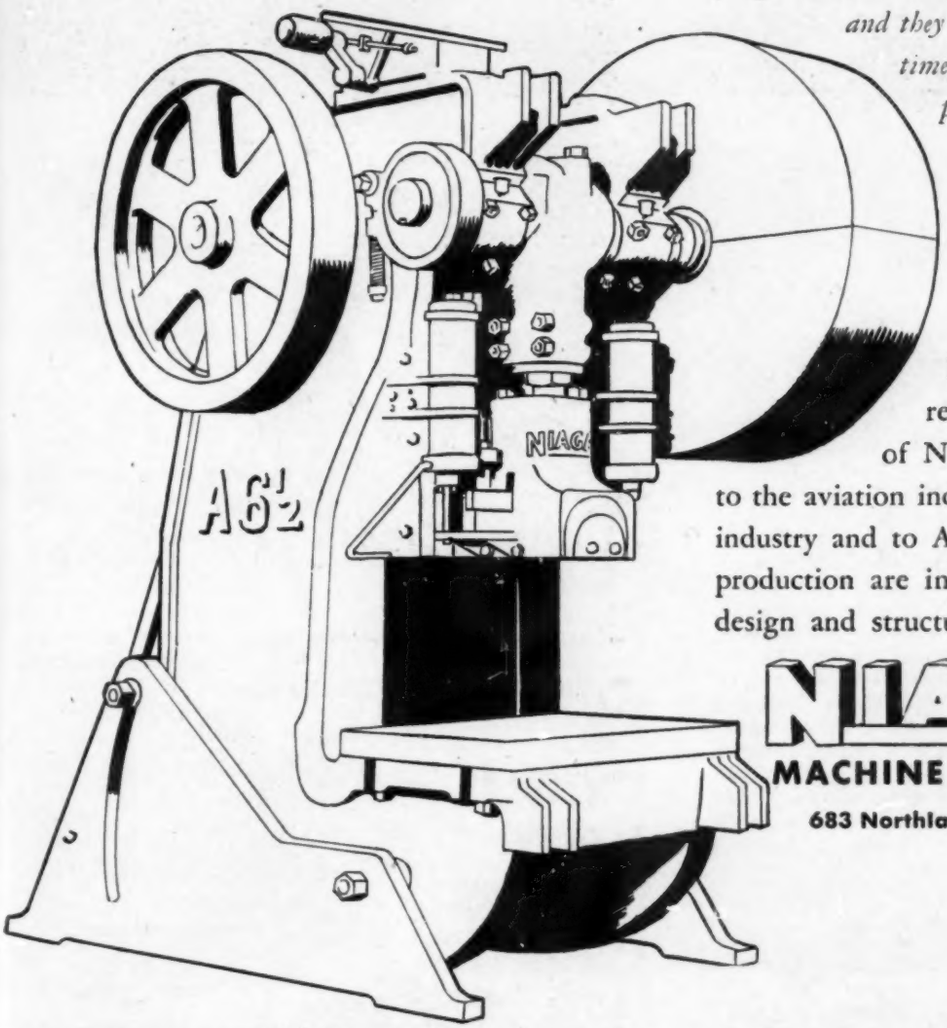
Great Names in America's Progress

GLENN CURTISS

The name Glenn Curtiss is the name of a great pioneer in aviation. Planes bearing the Curtiss name have fought their victorious way through two world wars, and they are playing a vital part in peacetime progress by transportation of mail, passengers and freight.



Presses and shears bearing the name NIAGARA have been important production tools in building thousands of planes of all makes. The NIAGARA performance record with Curtiss is typical of NIAGARA service not only to the aviation industry but the metal working industry and to America. Men responsible for production are invited to check NIAGARA design and structural features.

NIAGARA

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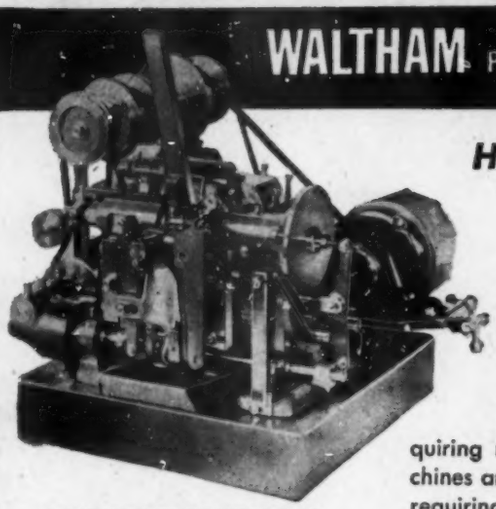
WALTHAM PINION & GEAR CUTTING MACHINES

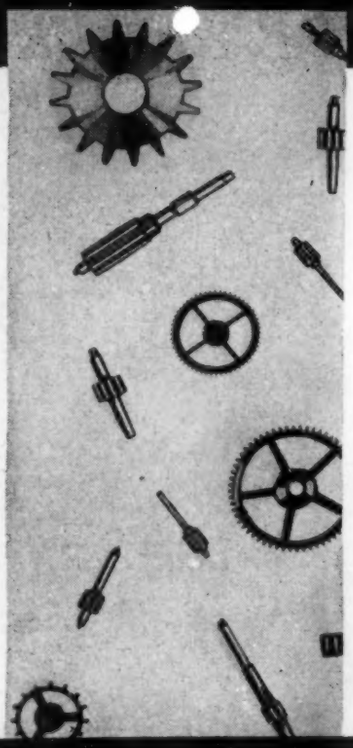


Highly productive—fast and accurate

These machines—made in single-cut, multiple-cut and magazine-feed types—are designed for the fast, precision production of gears and pinions for watches, instruments, fuses, etc. They are simple to operate, requiring no special skill. Magazine-feed machines are fully automatic, the other machines requiring positioning of blank and starting by hand.

Drive for these machines is either from countershaft or by individual motor. On motor driven machines, V-belts drive cutter spindle, worm shaft and pump.

Illustrated literature and detailed specifications are available promptly on request.



SPECIFICATIONS

PINION MACHINES

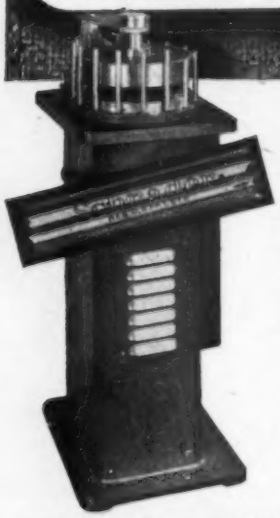
Diameter capacity, approx. ½"
Coarsest pitch about 32 D.P.
Strokes of Work slide for pinions—.24" to .45"
Strokes of work slide for stacked gears —.85 to 1"

GEAR MACHINES

Pitch diameter, capacity 1½"
Strokes for work slide, .40", .65", 1.00", 1.25"

WALTHAM MACHINE WORKS
WALTHAM, MASS.

WALTHAM
TRADE MARK REGISTERED U.S. PAT. OFF.



Let Noblewest's forty-one years of experience in designing and building the world's finest marking equipment help you solve your marking problems. Whatever your requirements — speed — precision — accuracy. Whatever the size or shape of your product, we will gladly make time and money-saving recommendations. Model No. 167, shown here, tooled for marking tire pressure gauges. Write Noble & Westbrook Manufacturing Co., 17 Westbrook St., East Hartford 8, Conn.

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NOBLEWEST

Hi-Speed Marking Machines

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Consistent Quality

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DIE CASTERS
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VERTICAL MILLERS
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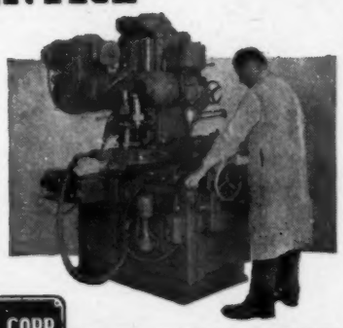

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CHIP WRINGERS

Take advantage of this great, *two way* money-saving opportunity! First:—A big, *immediate* saving in the purchase of this fine equipment at prices which average less than 50% of acquisition cost. Second:—A sizeable, *continuous* saving when these wringers are put to work separating and reclaiming valuable coolants, cutting oils and machine turnings.

Hundreds of units are offered. The various types were all made by leading manufacturers of such equipment. Diameters range from 26 to 48 inches. All models feature standard types of drive. Allied equipment and accessories are also offered in this great, fraction-of-cost sale.

For complete specifications, prices, inventory locations, arrangements for inspection of equipment, and conditions of sale, contact Chief, Sales Section 67 at your nearest War Assets Administration Regional Office. Locations of Regional Offices are indicated below. If your Regional Office cannot supply you with the machines you need, contact the Regional Office Customer Service Center and request them to locate the desired equipment for you.

Priority claimants have already had an opportunity to fulfill their needs.

EXPORTERS: Your business is solicited. Offers of this type should be promptly transmitted to your foreign clients.

1064-B

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WAR ASSETS ADMINISTRATION

GOVERNMENT WAA SURPLUS

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and its capacity to promote economic well-being for all

BASED ON A FIVE YEAR STUDY

by a committee of top business leaders and economists . . . commissioned by the

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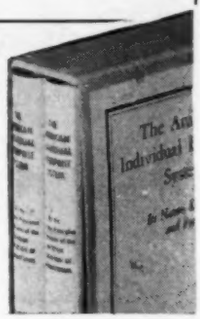
HERE is a vital message for every red-blooded believer in American democracy. It has been prepared in response to today's clamor for realistic and factual explanation of our economic system. Compiled by top-flight economists and businessmen, this two-volume book provides you with an authentic definition and explanation of the free enterprise system in its entirety—and how it benefits the individual. It clearly and factually discusses the nature of the system, tells how it operates, describes its achievements, and points out its goals and future problems.



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THE AMERICAN INDIVIDUAL ENTERPRISE SYSTEM

By the Economic Principles Commission of the
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Two volumes, boxed, 1100 *pages,* 6 *x* 9, $10.00

Here for the first time is a unified statement of the principles and objectives of our American system, incorporating the findings of several research studies. The two volumes describe in clear detail exactly how the American individual enterprise system functions. The principles and practices which will promote the achievement of its goal—maximum economic good for the American people—are soundly discussed from your viewpoint as a citizen.

Gives answers to such timely questions as:

What is the nature, with underlying philosophy, of the American economic system? How has it evolved during the 160 years of our nation's history? (See chapters 1-3)

What types of business organization have been developed under it, and why? (See chapter 4)

What changes in employment relations have occurred, what principles and practices in this relationship fit present conditions? (See chapter 5)

What are the roles of prices and profit in our enterprise system? (See chapters 9-10)

What have been the achievements of the American economic system? (See chapter 17)

What is Industry's program for America's future? (See chapters 20-21)

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BOYAR-SCHULTZ REVOLVING STOP

● Tests have proved that it is no longer economical to make your own stock stops for screw machines. It is real economy instead, to use the new Boyar-Schultz Revolving Stop

This new Tool, with free turning live head, reduces friction between work and stop, preventing marring of piece parts

Due to its design and precision manufacture it helps eliminate variation in piece-part lengths Its enclosed ball-bearing races prevent entrance of chips and foreign material, assuring long life, far greater than is expected from ordinary stops

Its low price brings new economy into your screw machine operations

WRITE FOR OUR NEW SCREW MACHINE TOOL CATALOG

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"we proved our ability to be of service . . ."

says W. H. Hulster

STUART OIL COMPANY
REPRESENTATIVE

Stuart Oil Performance Report on ThredKut 61

Type of product manufactured by company covered in this report:
Machined parts from rough forgings

Personnel interviewed:
Machine Shop Supt. and General Foreman

Stuart Oil Products used in this plant:
ThredKut 61, Solvol

Specific operations covered by this report:
Drilling and boring forged "8060" steel pump liners

Performance details:
"Problem was presented here in boring 7⅞" dia. holes through 11" dia. x 30⅛" solid forged pump liners running about 170 Br. Liners are run on two heavy duty lathes, one starting with a 1" dia. drill followed with a boring bar; the other a heavy boring bar used for removing entire 7⅞" of stock.

"Solvol was performing well on 4615 steel, but when 8060 steel was substituted, they could barely get 1 to 1¼ liners per day, from one lathe. Switching to ThredKut, tool life improved, but still only get one liner per-tool grind, plus terrific vibration.

"Then they called us in on the trouble. Our inspection of tool indicated dilution was in order. A 6-1 blend of ThredKut and Fpfe. was decided upon...and it licked the job...they now turn out 3⅜ liners per day per lathe, meeting production schedules...and are very appreciative of our help in solving this problem."

W. H. Hulster

HERE is another case where Stuart engineering service played an important part in solving a tough cutting problem. No "panacea" for all metal-working ills, Stuart Oil products must be used correctly to meet specific requirements. In this instance, the *right* oil was being used, but without necessary dilution. Our background and experience in helping to solve scores of similar problems is available to assist *you* in analyzing cutting fluid requirements. Write for further information.

Illustrated is one section of the completely equipped Stuart Metallurgical Laboratory, where the "Straight Line to Metal-Working Efficiency" begins.

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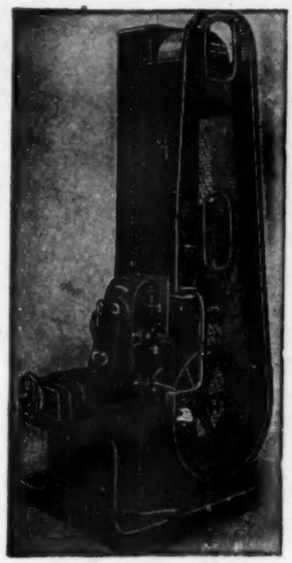
***The* TYPE "A" PRODUCTION**
High Speed — Centerless Feed
POLISHING MACHINE
No Centering or Chucking Work Fed Automatically.

The Type "A" is a high speed, centerless feed unit for polishing and finishing metals, fibre, wood, rubber. A power feed attachment makes it possible to feed cylindrical work in long or short lengths automatically. With Taper Feed Attachment, tapered cylindrical work can be handled continuously.

An outstanding feature of this machine is the use of a two-belt system which provides for chip disposal immediately, resulting in finer finish work. Capacity with power feed attachment, is ¼" to 6" diameter round stock.

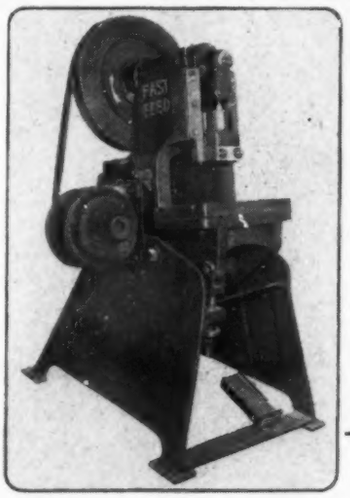
Write for illustrated literature



Specifications

Speed Leather Cushion Belt—6300 Ft. per min.
Floor Space—40"x50".
Height—89".
H.P.—10

Production
MACHINE COMPANY GREENFIELD, MASSACHUSETTS, U.S.A.



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29

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Drilling Machine—Multiple Spindle, Fixed Center-Drills, Natco.

Gear Tooth Grinder—For Spur Gears, External and Internal (Formed Wheel Type Machine).

Gear Tooth Lapper—External and/or Internal Gear Tooth Lapping Machine.

Gear Tooth Shaver—Rack or Rotary Type, External or Internal Gear Shaver.

Contour Cutter Grinder.

Grinders, Cam and Crank Pin.

Grinders, Miscellaneous—Spline and Radius Grinders.

Lapping Machines—Flat, Norton Hydrolap.

Lathes, Production—Between Centers Automatic, Horizontal Single Spindle.

Slot Milling Machine.

Milling Machine—Spline.

Milling Machine—Bed Type, Vertical.

Planer—Craven Bros.

Screw Machine—Multiple Spindle Bar Type Automatic.

Vertical Shapers and Slotters.

Speed Lathes—All Types and Sizes.

The following types of tools were originally repriced on October 1st. They are listed again because additional makes and models have been put on the new fixed price schedule.

Gear Hobber—Horizontal.

Gear Hobber—Vertical, Muir.

Gear Tooth Grinder—Generating Type, For Spur and Helical Gears.

Milling Machine—Bed Type, Horizontal Spindle, Plain or Rise and Fall, Simplex or Duplex.

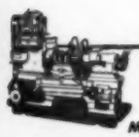
Milling Machine—Vertical, Knee Type Except Bench Models.

Tapping Machine—Vertical, Single or Multiple Spindle.

1947

bargains like this ready for IMMEDIATE DELIVERY

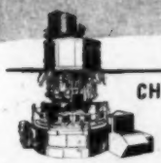
GOVERNMENT WAA SURPLUS



LATHES, PRODUCTION—BETWEEN CENTERS AUTOMATIC, HORIZONTAL SINGLE SPINDLE

Manufacturer: **JONES AND LAMSON MACHINE CO., SPRINGFIELD, VT.**

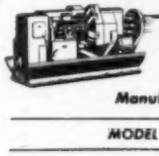
MODEL	SIZE AND CAPACITY	SALES PRICE
8" Fay Automatic	8" swing x 21" center to center	$ 796.00
8" Fay Automatic	8" swing x 33" center to center	843.00
8" Fay Automatic	8" swing x 45" center to center	889.00
12" Fay Automatic	12" swing x 21" center to center	$1195.00
12" Fay Automatic	12" swing x 33" center to center	1261.00
12" Fay Automatic	12" swing x 45" center to center	1330.00
12" Fay Automatic	12" swing x 63" center to center	1465.00
12" Fay Automatic	12" swing x 81" center to center	1636.00
16" Fay Automatic	16" swing x 21" center to center	$2079.00
16" Fay Automatic	16" swing x 33" center to center	2148.00
16" Fay Automatic	16" swing x 51" center to center	2284.00
20" Fay Automatic	20" swing x 25" center to center	$1569.00
20" Fay Automatic	20" swing x 37" center to center	1638.00
24" Fay Automatic	24" swing x 69" center to center	2717.00
Manufacturer: **LODGE AND SHIPLEY MACHINE TOOL COMPANY, CINCINNATI, OHIO**		
No. 1 "Duomatic"	16" swing over bed, 10" over slides, 39" centers	$1078.00
No. 3A "Duomatic"	20" swing over bed, 10" over slides, 15" centers	1772.00
No. 3A "Duomatic"	20" swing over bed, 10" over slides, 27" centers	1826.00
No. 3A "Duomatic"	20" swing over bed, 10" over slides, 39" centers	1879.00
No. 3A "Duomatic"	20" swing over bed, 10" over slides, 51" centers	1932.00
No. 3A "Duomatic"	20" swing over bed, 10" over slides, 63" centers	1986.00
No. 3A "Duomatic"	20" swing over bed, 10" over slides, 75" centers	2039.00
Manufacturer: **SENECA FALLS MACHINE COMPANY, SENECA FALLS, N. Y.**		
IMP Lo-Swing	4-1/2" swing over front and rear carriage, 8" centers	$ 746.00
IMP Lo-Swing	4-1/2" swing over front and rear carriage, 12" centers	769.00
LR Lo-Swing	5-1/2" swing over front and rear carriage, 10" centers	768.00
LR Lo-Swing	5-1/2" swing over front and rear carriage, 16" centers	815.00
LR Lo-Swing	5-1/2" swing over front and rear carriage, 22" centers	$ 854.00
LR Lo-Swing	5-1/2" swing over front and rear carriage, 34" centers	965.00
LR Lo-Swing	5-1/2" swing over front and rear carriage, 46" centers	1021.00
R-14 Lo-Swing	11-1/2" swing over front and rear carriage, 34" centers	2627.00
Manufacturer: **SUNDSTRAND MACHINE TOOL COMPANY, ROCKFORD, ILL.**		
8 Automatic Lathe	8" swing x 15" center to center	$ 715.00
8 Automatic Lathe	8" swing x 21" center to center	757.00
8 Automatic Lathe	8" swing x 28" center to center	816.00
10 Automatic Lathe	10" swing x 16" center to center	$ 976.00
10 Automatic Lathe	10" swing x 22" center to center	1020.00
10 Automatic Lathe	10" swing x 34" center to center	1128.00
10 Automatic Lathe	10" swing x 46" center to center	1242.00
12 Automatic Lathe	12" swing x 22" center to center	$1126.00
12 Automatic Lathe	12" swing x 34" center to center	1233.00
12 Automatic Lathe	12" swing x 46" center to center	1349.00
15 Automatic Lathe	15" swing x 22" center to center	$1102.00



CHUCKING MACHINE—AUTOMATIC, VERTICAL, MULTIPLE SPINDLE TYPE

Manufacturer: **BULLARD COMPANY, BRIDGEPORT, CONN.**

MODEL	SIZE AND CAPACITY	SALES PRICE
D "Mult-au-Matic"	34" swing 4 spindle	$19393.00
D "Mult-au-Matic"	8" swing 6 spindle	6136.00
D "Mult-au-Matic"	12" swing 6 spindle	6506.00
F "Mult-au-Matic"	7" swing 12 spindle	6380.00



SCREW MACHINE—SINGLE AND MULTIPLE SPINDLE BAR TYPE AUTOMATIC

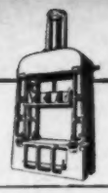
Manufacturer: **CONE AUTOMATIC MACHINE COMPANY, WINDSOR, VT.**

MODEL	SIZE AND CAPACITY	SALES PRICE
SK Automatic Screw Machine	1-1/2" diameter bar capacity, 6 spindle	$3066.00
SN Automatic Screw Machine	2" diameter bar capacity, 6 spindle	3307.00
SD Automatic Screw Machine	2-1/4" diameter bar capacity, 6 spindle	3446.00
SE Automatic Screw Machine	2-5/8" diameter bar capacity, 6 spindle	3932.00
SF Automatic Screw Machine	3-1/2" diameter bar capacity, 6 spindle	4432.00
WW Automatic Screw Machine	1-1/2" diameter bar capacity, 8 spindle	$3065.00
XX Automatic Screw Machine	1-7/8" diameter bar capacity, 8 spindle	3132.00
DD Automatic Screw Machine	1-1/2" diameter bar capacity, 8 spindle	2360.00
VB Automatic Screw Machine	1-5/8" diameter bar capacity, 8 spindle	3132.00
MM Automatic Screw Machine	1-7/8" diameter bar capacity, 8 spindle	2529.00
Manufacturer: **GREENLEE BROTHERS AND COMPANY, ROCKFORD, ILL.**		
1" Automatic Screw Machine	1" diameter bar capacity, 6 spindle	$2216.00
1-5/8" Automatic Screw Machine	1-5/8" diameter bar capacity, 6 spindle	2636.00
2" Automatic Screw Machine	2" diameter bar capacity, 6 spindle	3269.00
Manufacturer: **THE NATIONAL ACME COMPANY, CLEVELAND, OHIO**		
3/8" R-6 Automatic Screw Machine	3/8" diameter bar capacity, 6 spindle	$2105.00
9/16" RA-6 Automatic Screw Machine	9/16" diameter bar capacity, 6 spindle	1602.00
1" RA-6 Automatic Screw Machine	1" diameter bar capacity, 6 spindle	3036.00
1-1/4" RA-6 Automatic Screw Machine	1-1/4" diameter bar capacity, 6 spindle	3465.00
1-5/8" RA-6 Automatic Screw Machine	1-5/8" diameter bar capacity, 6 spindle	$4118.00
1-5/8" RB-6 Automatic Screw Machine	1-5/8" diameter bar capacity, 6 spindle	4118.00
2" RA-6 Automatic Screw Machine	2" diameter bar capacity, 6 spindle	4350.00
2" RB-6 Automatic Screw Machine	2" diameter bar capacity, 6 spindle	4350.00
2" RAS-6 Automatic Screw Machine	2" diameter bar capacity, 6 spindle	$4350.00
2-5/8" RA-6 Automatic Screw Machine	2-5/8" diameter bar capacity, 6 spindle	4969.00
2-5/8" RB-6 Automatic Screw Machine	2-5/8" diameter bar capacity, 6 spindle	4969.00
3-1/2" RA-6 Automatic Screw Machine	3-1/2" diameter bar capacity, 6 spindle	5781.00
Manufacturer: **NEW BRITAIN-GRIDLEY MACHINE COMPANY, NEW BRITAIN, CONN.**		
60 Automatic Screw Machine	5/8" diameter bar capacity, 6 spindle	$1778.00
204 Automatic Screw Machine	5/8" diameter bar capacity, 6 spindle	1059.00
60 Automatic Screw Machine	1" diameter bar capacity, 6 spindle	2741.00
61 Automatic Screw Machine	1-3/8" diameter bar capacity, 6 spindle	$2299.00
61 Automatic Screw Machine	1-5/8" diameter bar capacity, 6 spindle	3373.00
61 Automatic Screw Machine	2" diameter bar capacity, 6 spindle	3560.00
61 Automatic Screw Machine	2-1/4" diameter bar capacity, 6 spindle	3662.00

CHUCKING MACHINE—SIX SPINDLE AUTOMATIC, HORIZONTAL

Manufacturer: **NEW BRITAIN-GRIDLEY MACHINE COMPANY, NEW BRITAIN, CONN.**

MODEL	SIZE AND CAPACITY	SALES PRICE
Automatic, Work Rotating Chucker	2" swing	$2682.00
Automatic, Work Rotating Chucker	3-1/2" swing	2885.00
Automatic, Work Rotating Chucker	5-3/4" swing	3058.00
Automatic, Work Rotating Chucker	6-1/2" swing	5139.00
Automatic, Work Rotating Chucker	7-1/2" swing	$5313.00
Automatic, Work Rotating Chucker	9" swing	4863.00
Automatic, Work Rotating Chucker	10-1/4" swing	5458.00
Automatic, Work Rotating Chucker	5-3/4" swing	3058.00
Manufacturer: **THE BAIRD MACHINE COMPANY, BRIDGEPORT, CONN.**		
Automatic, Work Rotating Chucker	7" swing	$3880.00



FORGING MACHINERY AND HAMMERS—IMPACT STAMPING TYPE

Manufacturer: **CHAMBERSBURG ENGINEERING COMPANY, CHAMBERSBURG, PA.**

MODEL	SIZE AND CAPACITY	SALES PRICE
Elpic Coco Stamp	30" R to L, 24" F to B, 36" stroke	$1343.00
Elpace Coco Stamp	48" R to L, 36" F to B, 42" stroke	2074.00
Elplain Coco Stamp	48" R to L, 48" F to B, 42" stroke	2455.00
Elpoint Coco Stamp	66" R to L, 36" F to B, 48" stroke	2471.00
Elplank Coco Stamp	66" R to L, 48" F to B, 48" stroke	$3684.00
Elplanet Coco Stamp	66" R to L, 60" F to B, 48" stroke	3896.00
Elpale Coco Stamp	96" R to L, 48" F to B, 48" stroke	3922.00
Elpublic Coco Stamp	96" R to L, 60" F to B, 48" stroke	4642.00

25%

OR MORE BELOW USED MARKET

- purchasing can be done either directly with the 33 WAA Regional Offices or with one of the 3,000 "approved" dealers.
- one low price everywhere — any regional office, dealer or site sale.
- no waiting for priorities, complicated figuring of prices or other delays.

MILLING MACHINE—BED TYPE, HORIZONTAL SPINDLE PLAIN OR RISE AND FALL, SIMPLEX OR DUPLEX

Manufacturer: **BROWN AND SHARPE MFG. CO., PROVIDENCE, R. I.**

MODEL	SIZE AND CAPACITY	SALES PRICE
Plain (Simplex)	6" table travel x 8" width	$ 394.00
Plain, Electrically Controlled (Simplex)	12" table travel x 10" width	789.00
Plain, Electrically Controlled (Simplex)	18" table travel x 12" width	969.00
Plain, Electrically Controlled (Simplex)	24" table travel x 12" width	1009.00
Manufacturer: **CINCINNATI MILLING AND GRINDING MACHINES, INC., CINCINNATI, O.**		
Plain, Hydromatic	36" table travel x 16" table width	$1550.00
Plain, Hydromatic	48" table travel x 20" table width	1918.00
Plain, Hydromatic	90" table travel x 24" table width	2807.00
Duplex, Hydromatic	36" table travel x 16" table width	2471.00
Manufacturer: **KEARNEY AND TRECKER CORPORATION, MILWAUKEE, WIS.**		
Automatic, Simplex	18" table travel x 12" table width	$1206.00
Automatic, Simplex	42" table travel x 18" table width	1623.00
Automatic, Simplex	54" table travel x 18" table width	1662.00
Manufacturer: **KENT-OWENS MACHINE COMPANY, TOLEDO, OHIO**		
Plain, Hydraulic, Single Spindle	8" table travel x 9" width	$ 454.00
Plain, Hydraulic, Double Spindle	20" table travel x 12" width	1433.00

DRILLING MACHINE—MULTIPLE SPINDLE WITH CENTRAL DRIVING UNIT

Manufacturer: **NATIONAL AUTOMATIC TOOL CO., INC., RICHMOND, IND.**

These prices apply only to exact model listed and cover types with nonadjustable fixed center drill spindle or spindles which are all driven by a separate motor mounted directly above spindle gear box and moving vertically with the gear box.

MODEL AND DESCRIPTION	SALES PRICE
Mod. B-2A Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	$1417.00
Mod. B-3A Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	1780.00
Mod. B-4A Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	2196.00
Mod. B-5A Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	4052.00
Mod. 2-AL Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	$1417.00
Mod. 3-AL Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	1780.00
Mod. 4-AL Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	2196.00
Mod. 5-AL Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	4052.00
Mod. 2-AH Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	$1417.00
Mod. 3-AH Natco Vert. Multi-Spindle Fixed Centers Drill With Separate Spindle Driving Motor	1780.00

The above prices do not apply to general purpose adjustable Multi-Spindle Natco drilling machines equipped with slip spindle plates or with standard adjustable spindles.

ALL TOOLS SUBJECT TO PRIOR SALE

Get this new catalog list

If you can use any of the 29 additional types of production tools on which fixed prices have been established, send today for WAA's new (January 15) Fixed Price Machine Tool Catalog giving all sizes and new fixed prices.

PLUS—Catalog of sizes, models and prices of 31 types of production tools previously (October 15) placed on the fixed price list. For copies of one or both of these catalogs, simply write, phone or wire the nearest WAA office listed on the 4th page of this advertisement.

EXPORTERS: Your business is solicited. Much material which is surplus in the United States is urgently needed or is readily saleable in other countries. Watch for other offerings; many of them may be of interest to your clients.

WAR ASSETS ADMINISTRATION

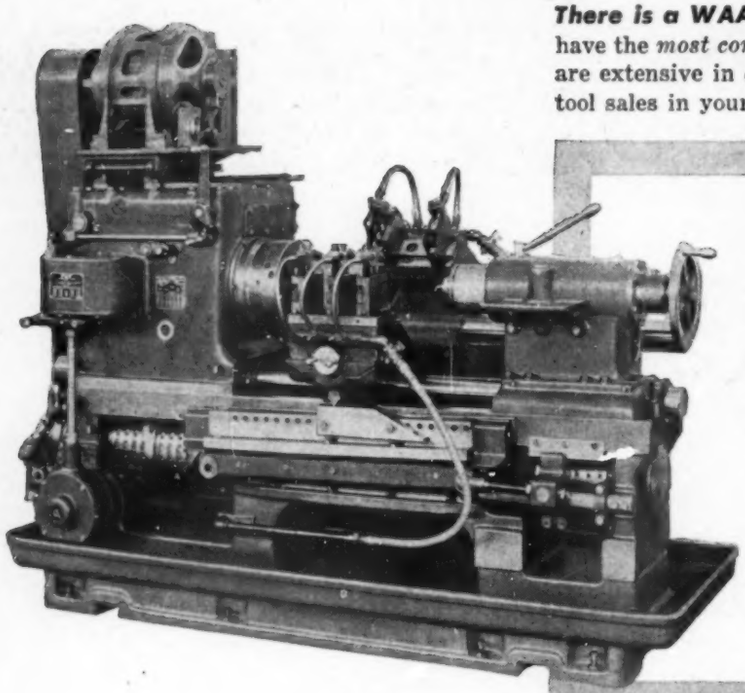
GOVERNMENT WAA SURPLUS

One Call ...

TO BUY AND GET DELIVERY

To purchase the machine tools you need, visit any of the WAA offices listed below, your regular machine tool dealer, or any WAA Machine Tool Site Sale advertised in your local paper. You can arrange *on the spot* for immediate delivery. Shipping time must be allowed for, however, when the particular machine you want is located elsewhere. But you will not have to wait for lengthy clearances of priorities or nation-wide search of stocks. All machines are available for immediate sale.

There is a WAA office near you – Offices listed below with a star have the *most complete* inventories of surplus machine tools—but stocks are extensive in *all* offices. Watch your newspaper for special machine tool sales in your area.



HOW NEW PRICE POLICY WORKS

New prices take into consideration the estimated cost of engineering and rebuilding the tools. For example:

Here is how WAA's new price has been set on a 20 inch Fay Automatic Production Lathe, 37" center to center, a Jones and Lamson machine. WAA code No. 3416-61-62-57.

Price (New)	$7,059.00
Previous WAA Sales Price (based on depreciation primarily)	3,529.00
Average Market Value	2,130.00
New WAA Fixed Sales Price	1,638.00
Available for Rebuilding	$ 492.00

MACHINE TOOL SALES DIVISION

OFFICE OF GENERAL DISPOSAL

WAR ASSETS ADMINISTRATION

GOVERNMENT WAA SURPLUS

Offices located at: Atlanta • Birmingham • *Boston • Charlotte • *Chicago • Cincinnati • *Cleveland Denver • *Detroit • Grand Prairie, Tex. • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • *New York • Omaha • *Philadelphia Portland, Ore. • Richmond • Salt Lake City • *St. Louis • San Antonio • San Francisco • Seattle • Spokane • Tulsa

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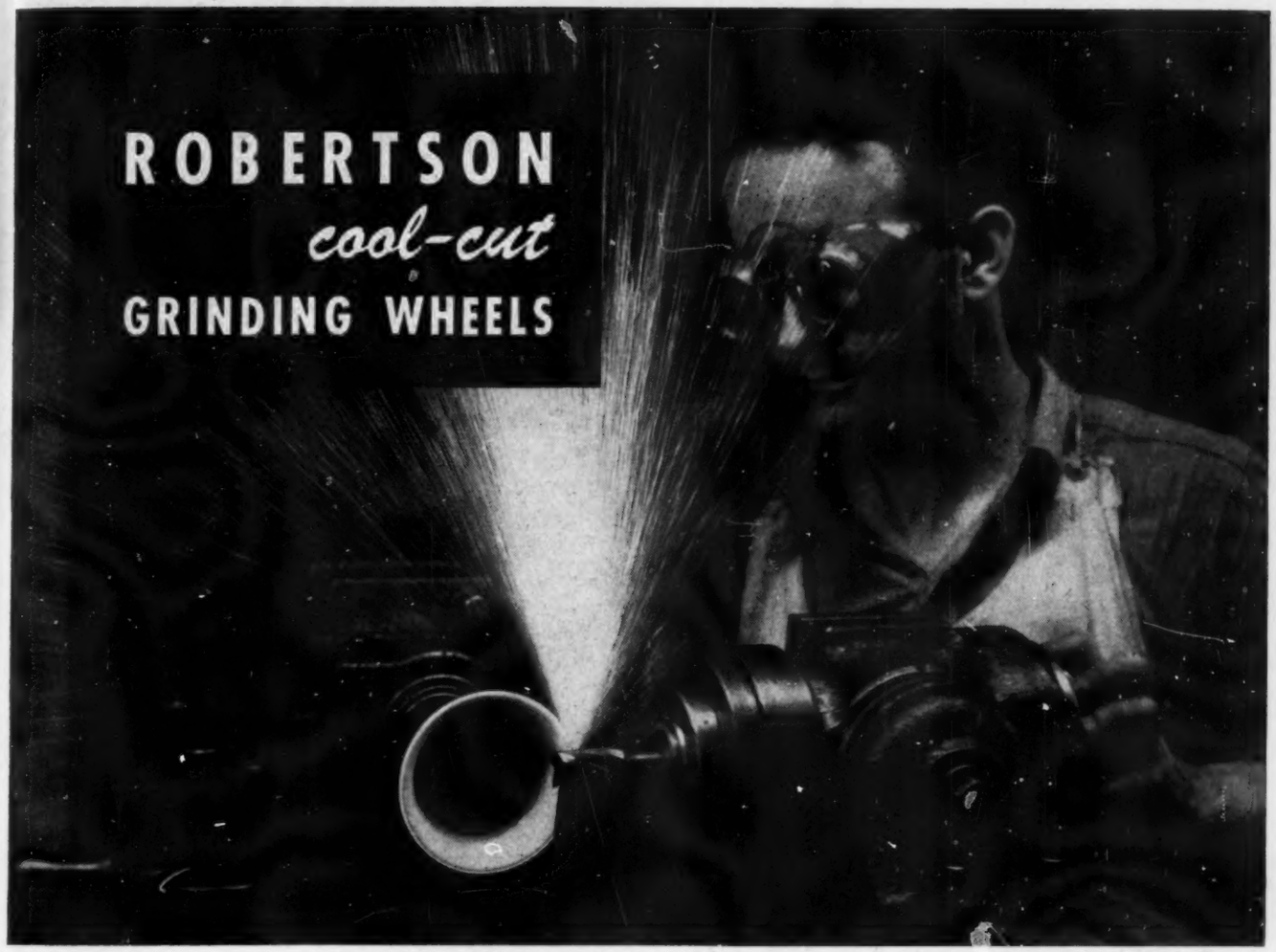

Unretouched photo of Robertson Flaring Cup Cool-Cut in action in precision-tool manufacturing plant. (Name of plant on request.)

PRECISION MADE . . .
FOR PRECISION PERFORMANCE

PICK UP A Robertson Cool-Cut Grinding Wheel and examine it closely. Look at it under a magnifying glass. Note the uniform structure, the fine finish . . . sure signs of high-quality workmanship. Then, put the wheel to work.

What your eyes have told you, the finished work will confirm. With Robertson Cool-Cut Wheels you'll produce work more accurately held to size, with the desired finish, and with less effort than with any comparable wheel. Quality such as you find in Robertson wheels is not a result of hit-or-miss methods. It is the result, rather, of painstaking care from raw materials to finished product . . . and, even more, of Robertson's 50 years' experience in the operation of high-temperature furnaces.

The direct result of Robertson's precision methods is precision performance . . . faster and more accurately-ground work. Many users report: "Cuts grinding time in half" . . . "Production tripled" . . . "Reduces tool-grinding costs 10% to 20%." For all grinding operations—even the tough ones—you'll get top results with Robertson Cool-Cut Wheels. Send for free copy of the booklet, "How to Buy Production Time."

ROBERTSON MANUFACTURING COMPANY
TRENTON 5, NEW JERSEY

Manufacturers of Vitrified Grinding Wheels • Mounted Wheels • Segments

M.R.E.
RADIUS ATTACHMENT

The M. R. E. Radius Attachment operates on an entirely new principle that does away with the necessity of setting the workpiece or diamond to a given distance from a central pivot. No part of the fixture moves more than the desired amount as measured on the Vernier Scale, which gives it a distinct advantage over other types of radius attachments which describe a circle greater than the one required and often foul the head of the machine before a complete half-circle is produced on the workpiece.

Convex and concave work of various radii up to 1½" can be produced with one width of wheel by adjusting the table. The M. R. E. Radius Attachment can be used on lathes, surface grinders, cylindrical grinders, vertical and horizontal milling machines, etc. It can be used as an indexing attachment for jig boring by using an index plate supplied by the makers.

Equipment includes universal head, diamond holder and indexing finger. Centers and blocks can be supplied if required. The attachment is 9½" long x 14" x 5" high. Weight with universal head and diamond holder, 52 pounds. *Write today for complete information.* Address Dept. AM-4.

A few of the components which can be processed by the M. R. E. Radius Attachment.

ACCREYLON COMPANY, INC. 130 West 42nd St., New York 18, N. Y.

Sole U. S. Agent

Mfd. by Manchester Repetition Engineers, Ltd., Manchester, England

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Almond Drill Chuck

. . for over 70 years

ALMOND THREE-JAW DRILL CHUCKS—the first to be placed on the market more than seventy years ago—pioneered the ALMOND CHUCKS have field of drill chucks. During all these many years, continued to be a necessary part in the logical procedure of machine developments.

Made in types and sizes to fit all machine tools and portable drills.

Write for further information.

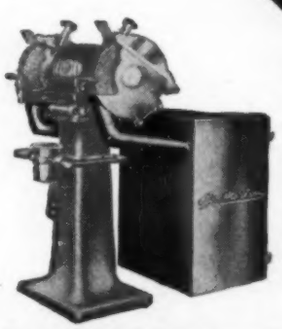
The Original Manufacturers of Drill Chucks

T. R. ALMOND MFG. CO.

Ashburnham, Mass., U.S.A.

TINY . . . BUT DESTRUCTIVE!

Millions of tiny particles of dust and grit fly off unprotected grinder and buffer wheels daily . . . enter and injure the lungs of your employees . . . cause breakdowns of expensive machinery by getting into sensitive moving parts and bearings. Eliminate dust and grit by installing the AIR MASTER.



The AIR MASTER sucks dust and grit right off the whirling wheels of grinders and buffers, leaving the air free from these destroyers of health and machinery.

The AIR MASTER is fully self-contained . . . efficient, rugged, dependable. A size for every grinder and buffer.

Write today for full details

TRADE *The Cincinnati* MARK

THE CINCINNATI ELECTRICAL TOOL CO.

Division of THE R. K. LeBLOND MACHINE TOOL CO.

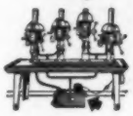
2615 Madison Road, Cincinnati 8, Ohio

GRAY-MILLS

PORTABLE

PUMP UNITS

Use these compact self-contained units as



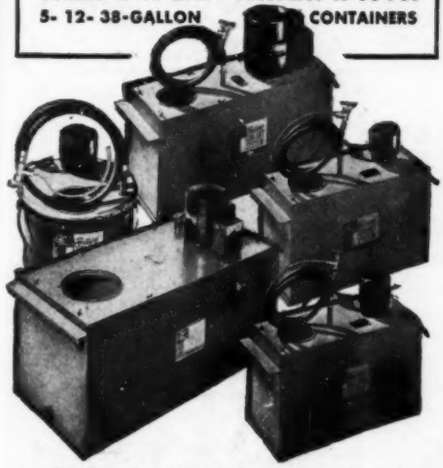
...Coolant Systems for all types of Machine Tools

...Stand-by Pump Units in case your built-in pumps fail

...automatic Die or Stock Lubricators on punch presses
(Ideal for coil stock)

...for hundreds of special applications—circulating or applying liquids of many kinds

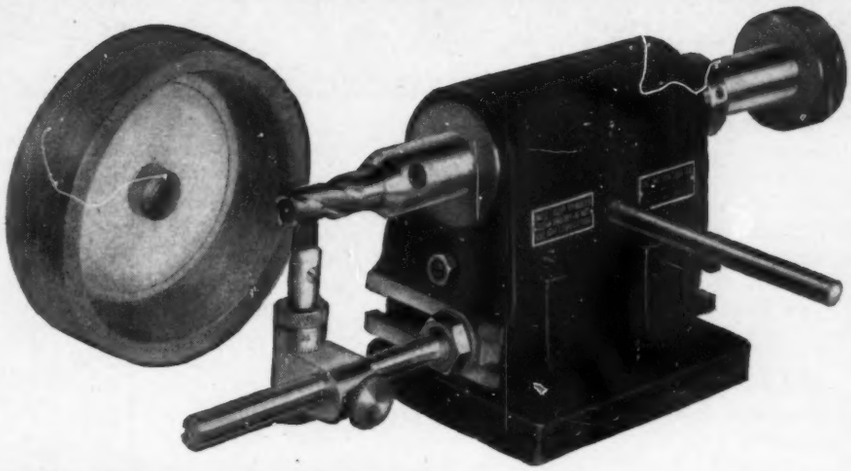
GEAR and CENTRIFUGAL PUMPS
Volume to 43 GPM—Pressures to 50 PSI
5- 12- 38-GALLON CONTAINERS



See Your Industrial Distributor or write to Gray-Mills for catalog

GRAY-MILLS CORPORATION
1953 Ridge Ave. Evanston, Illinois

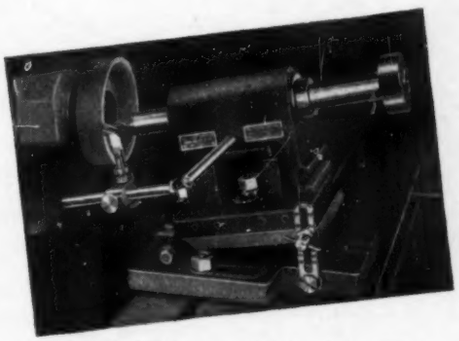
YESTERDAY'S PIONEER . . . TODAY'S LEADER



WELDON
End Mill Sharpening Fixture

The *Weldon* Sharpening Fixture quickly resharpens end mills from 1/16 to 2″ inclusive. Requires no centers or lead cams. Unnecessary to line up the fixture as it will always grind straight. Designed for any grinder with flat table. No table movement necessary. Requires little skill to operate.

WELDON
ADJUSTABLE SUB-BASE
makes sharpening end teeth easy



Write for Folder No. 590

Designed for easy attachment to the Weldon Sharpening Fixture the Sub-Base adjusts to any selected angle and makes simple the job of sharpening the end teeth of all style end mills. No alterations needed. Simply bolt to Fixture through same slot used to fasten Fixture to grinding machine.

THE WELDON TOOL CO. *Cleveland 4, Ohio*

3000 WOODHILL ROAD

Positive action of BARRETT TYPHOON CENTRIFUGAL WASHERS provides for quick, thorough parts cleansing

In these efficient centrifugal machines the washing solution enters the top of the whirling load under valve control. The operating principle—being that of a typhoon—gives the washing solution a spraying, swirling, and surging action which thoroughly permeates the contents. During this action, centrifugal force creates hydrostatic pressure within the basket. That proportion of the deluge going to the bottom is forced up the side and out carrying off the contaminated fluid.

A thorough, quick cleaning is definitely assured by flowing sequence. Two or more liquids may follow, making it possible to wash, rinse or provide any further treatment as required.

Several Barrett installations involve the use of four machines operated by one man who loads and unloads in three minute cycles. Washing time is only one minute. Another type of set-up provides for recovering oil, washing, drying, and coating with rust-proofing material.

As in all Barrett Centrifugal machines, provision is made for convenience and safety of operation.

Send at once for details of Barrett Typhoon Washer

Barrett Centrifugal Washer—made in capacities from 13 to 38 cu. ft. per hour. Each size, depending on condition, will perform at the rate of 20 duty cycles per hour.

THE LEON J. BARRETT COMPANY, 1800 Grafton Road, **WORCESTER, MASS.**

Designers and Builders of Centrifugal Machinery

For Faster Smoother Cleaner *Grinding* **ECONOMY**

Grinding and Cutting Oils and Lubricants for Every Metal Working Purpose

THE WHITE & BAGLEY COMPANY

WORCESTER 8, MASS., U.S.A.

Die-Making Machines

They save 50% on sawing, filing and lapping operations, easily maintaining .002" limits. Ask for special bulletin—also circulars on Drill Grinders, Point Thinners, Tool and Cutter Grinders, Face Mill Grinders and Tool Bit Grinders.

OLIVER OF ADRIAN PRODUCTS

Oliver Instrument Co., 1414 Maumee St., Adrian, Mich.

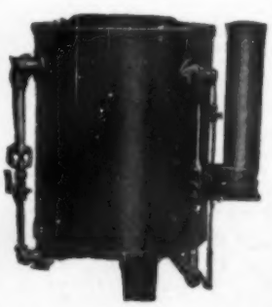
NUPLA PLASTIC HAMMER

HARD HITTING "SOFTY"! Remarkable new head on NUPLA Hammer will not mar, cut or bruise. Craftsmen prize it because . . .

- No chips, cracks, shreds, rebound, sting —or DISTORTION.
- Outlasts others ... to 1, 3 grades, 5 sizes, 29 weights. Non-Spark and Standard. Write!

H&H RESEARCH CO. 6309 HORATIO Detroit 10, Mich.

ATTAINS 1650° F. QUICKLY
Atmospheric Pot Hardening Furnace



"BUZZER" HIGH SPEED *Gas* FURNACES

. . . are the efficient, economical answer to today's Heat Treating Problems. **NO BLOWER or OTHER AUXILIARY POWER are needed . . . just connect to your gas supply.**

- The Full Muffle Furnace attains a temperature of 2400° F., and The Pot Hardening Furnace, tangentially fired, assures quick even heat up 1650° F. Many other models available.
- Send for the "BUZZER" Catalog showing full line of Industrial Gas Furnaces, Burners and other equipment.

CHARLES A. HONES, INC.

121 So. Grand Ave. Baldwin, L. I., N. Y.

ATTAINS 2400° F. QUICKLY
Full Muffle Furnace

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WANTED PRODUCTS OF CONTRACT WORK

Machinery manufacturing concern with extensive experience desires a product to manufacture on a contract basis or straight contract work.

Manufacturer has modern well equipped machine shop, capable of making small, medium or large machinery, tools, jigs, fixtures, gages, stamping dies, stampings, electronic assemblies, gear drives and small parts of all types. Excellent engineering facilities and good contacts for all types of foundry work are available.

Send for our bulletin #10A

C. W. JARVI MFG. COMPANY, INC.
NORTH ATTLEBORO MASSACHUSETTS

Wood Patterns and Metal Patterns
For
All Types of Castings
Complete Machine Shop Facilities
Let us know how we can serve you

Elram Pattern Works
214-220 Adams St.,
Hoboken, N.J.

MACHINE WORK WANTED

Large mechanical engineering organization has open capacity for designing and building special machinery, tools, jigs, fixtures and general production machine work. All facilities are modern and our men are accustomed to precision machining.

23—Milling Machines, #1 to #4
16—Engine Lathes, 10" to 50"
6—Radial Drills, 3' to 6'
8—Vertical Boring Mills, 36" to 54"
2—Horizontal Boring Mills, 3" & 4" bar

Grinding and Heat Treating Equipment

An opportunity to quote on your requirements will be appreciated.

Plant location:—PHILADELPHIA, PENNA.

CW-895, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

SEND B.P. FOR MFG. COMPLETE ASSEMBLIES
Tool—Jigs—Dies
Screw Machine and Turret Lathe Work
Stampings—Gears

POSSY'S TOOL & MFG. CO.
51 Meadowbrook Buffalo 9, N. Y.

● Plates—Flame cut to size and shape—latest burning equipment. Can furnish our own steel—accurate work—prompt service.
● Equipped to do welding and fabricating in connection with this service. Send us blueprints or templet for quotation.

THE TOLEDO IRON AND STEEL CO.
A Complete Steel Warehouse Service
1819 STARR AVENUE, TOLEDO 5, OHIO

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Metal Fabrication Manufacturer with extensive production experience has additional capacity in small welding plant. Can perform sawing, flame shape cutting, drilling and welding operations. Send your inquiries or drawings to

THE B-H CO., INC., CAMBRIDGE CITY, IND.

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PATTERNS IN WOOD AND METAL
CASTINGS IN BRASS, BRONZE AND ALUMINUM

138 Stockton Ave., San Jose, Calif.

SCREW MACHINE and TURRET LATHE PRODUCTS
Gears, Sprockets, Standard and Special. Milling, Drilling and Surface Grinding. Short or Long Runs. Quick Delivery.
Send B.P. for Estimates.

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SPECIAL SPUR GEARS
Flanged Pinions, Internals
Up to 18" Pitch Dia.
Small Quantities Made Economically
Send B.P. for Quotations and Delivery

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PATTERNS in WOOD and METAL
For All Kinds of Castings, Large or Small
MATCH PLATE WORK A SPECIALTY
Put your pattern problems up to us — we will take care of them.

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EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

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MECHANICAL ENGINEERING Draftsmen—Examinations will be held for appointments in New York City departments. Salary range from $2160 to but not including $3120 per annum. Current appointments at $2400 plus $650 cost-of-living bonus. Open to residents of New York State and on some appointments—New York City. Write for Notice of Examination No. 5210. Municipal Civil Service Commission, 299 Broadway, New York 7, N. Y.

POSITIONS VACANT

TO A first class tool engineer and designer now holding a secure position of responsibility who wants to risk his present security for opportunity,—is offered a key position in a successful midwestern tool, machine and stamping shop with a chance to participate in its further growth. P-918, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

OUTSTANDING STEEL Producer with world-wide connections requires qualified, aggressive, practical Manager, Alloy & Tool Steels Department. Must be thoroughly familiar machining Heat Treatment, capable demonstrator, with sales ability. Excellent opportunity for right party. Do not call. Write, giving curriculum and salary expected, to P-917, American Machinist, 330 W. 42nd St., New York 18, N. Y.

POSITIONS VACANT

MACHINE TOOL Painter with experience wanted by middle-west shop. Apply by letter giving age and qualifications. P-885, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

SELLING OPPORTUNITIES OFFERED

SALES REPRESENTATIVE Wanted by manufacturer of the finest Die Sets on the market today. Territories available in all sections of United States and Canada. Must be acquainted with die work and have large acquaintance in their territories in this particular field. Commission basis. RW-908, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

MANUFACTURERS' REPRESENTATIVE wanted, experienced in abrasive field. Territories open on eastern seaboard. Commission basis. Write full particulars. RW-919, American Machinist, 330 W. 42nd St., New York 18, N. Y.

SALES ENGINEER Wanted. Well established and financially responsible add to your business our complete lines of goods—air cylinders. Man desired technical background and ability to help customers solve their problems. Write for state territories now open. RW-920, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

(Continued on page 242)

MANUFACTURING SUPERINTENDENT

With proven ability in machine shop and metal manufacturing. Must be capable of supervising light and heavy machine shop work, miscellaneous metal manufacturing, woodworking shop and foundry. College Graduate preferred between the ages of 35 and 40 years. This is a permanent position with well established nationally known company having a plant located on the Eastern Seaboard of Middle Atlantic States. Splendid opportunity for qualified man. Applicants should state qualifications fully in first letter and mail to

B-22, P.O. BOX 3495
Philadelphia 22 Pennsylvania

Additional Employment Advertising on page 242

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

(Not available for equipment advertising)

60¢ per line, minimum 4 lines. To figure advance payment count 6 average words as a line.

POSITIONS WANTED (full or part-time individual salaried employment only), ½ above rates.

PROPOSALS. 50 cents a line an insertion.

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BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. A.M.

NEW ADVERTISING received by 10 A. M. April 23rd will appear in the issue of May 8th subject to limitation of space available

SELLING OPPORTUNITIES OFFERED

(Continued from page 241)

SALESMAN WANTED by machine tool distributor in the east having broad lines. Must have engineering education and ability to process general machine shop work. Age approximately 30-35 years. State complete qualifications. SW-921, American Machinist, 330 W. 42nd St., New York 18, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of thirty-seven years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 266 Dunn Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

GEAR HOBBER and Threadmiller Serviceman with 11 years' road experience desires position in methods or foremanship in gear works. Former work consisted of troubleshooting, maintenance, and setup of single and rotary hobbers, threadmillers, and gear grinders, familiar with competitive makes of machines. PW-883, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

CHIEF INSPECTOR, engineering background; able to set up modern inspection department. Supervises any machine operation. Accustomed to closest tolerances. Lay-outs, tools, fixtures. 20 years' experience. Own latest precision tools. Best references. W. Basch, 224 W. 72nd, New York 23, N. Y., Phone: TR-4-4281.

WELL TRAINED and experienced personnel man wants position as personnel director or industrial counselor in progressive concern. Central or southwestern states preferred. Now school director of guidance, testing, and counseling in a city of 100,000. Have Phd. in guidance and personnel work besides wide background of industrial and administrative experience. Strong public relations. Norse descent; 38 years of age; excellent health; three children. Will furnish references and credentials upon request. Write or wire PW-912, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGINEER, graduate, age 46. Experience: 12 years industrial plant erection and maintenance and ships repairs; 5 years shop superintendent (foundry, structural and machine shops); 5 years Marine design Engineer (present position) main engines, auxiliaries, piping, ventilating and refrigeration in conversion work. Desire permanent supervisory position in similar lines of work. PW-922, American Machinist, 330 W. 42nd St., New York 18, N. Y.

EXPORT EXECUTIVE. World wide experience selecting foreign distributors. Sales promotion and selling abroad. Handling credits and collections. Linguist. Single, 40. PW-923, American Machinist, 330 W. 42nd St., New York 18, N. Y.

MECHANICAL ENGINEER and Designer: Age 33, experience—more than age indicates. Machine tool design, production engineering and planning, jig, tool and fixture design, machine tool selection and plant layout, gages and gaging practices, wood and metal pattern work, foundry practice, sales, plant management. Want position where hard work will be appreciated and bring results. Prefer bringing out new products or redesign of existing products and methods of manufacture. Engineering college graduate. Think experience worth more than degree. PW-924, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

SALESMEN WANTED

10 men to cover territories throughout the United States. Sole representative for one of the largest and progressive industrial diamond and diamond tool manufacturers in the country. Exclusive territories. Drawing and commission. State full details. Replies strictly confidential.

SW-916, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

SELLING OPPORTUNITIES WANTED

MECHANICAL ENGINEER with long established office and staff of competent engineers desires exclusive sales arrangement for high grade machine tool line requiring actual shop, production and enginering knowledge to sell. Have background of thirty years shop, engineering and sales experience with wide acquaintance throughout New York State. Location, central New York. RA-913, American Machinist, 330 W. 42nd St., New York 18, N. Y.

SALES ENGINEER, with following in New York, North Jersey, experienced selling high grade tools, desires line of small machines or tools of merit by reliable manufacturer. Technical background, exclusive sales, commission. SA-925, American Machinist, 330 W. 42nd St., New York 18, N. Y.

PATENT ATTORNEY

PATENT and Trade-Mark Practice before U. S. Patent Office Validity and Infringement Investigations and Opinions Booklet and form "Evidence of Conception" forwarded upon request. Lancaster Allwine & Rommel, Registered Patent Attorneys, Suite 453, 815-15th Street, N. W., Washington 5, D. C.

MANUFACTURING RIGHTS FOR GREAT BRITAIN

British manufacturers who are established specialists in tooling and manufacturers of a wide range of machines wish to obtain sole license to manufacture high class machines in Great Britain.

BO-915, AMERICAN MACHINIST
Aldwych House—Aldwych, London WC2, England

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REMOTE CONTROLS (Wires and Wireless)
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P. O. BOX 224 **ROCHESTER, N. Y.**

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Three #35 Excello Thread Grinders with all attachments and accessories; in excellent condition; three years old; operation hours less than 1,000.

Price for Immediate Sale $6,500.00 Each.

West Coast Machine & Tool Co.
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PETITT BROS. MACHINERY CO.
If You Want to Buy, Sell, or Trade
One Machine or Entire Plant
Consult Us Immediately
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THREAD GAGES — PLUG AND RING

Slightly used, NF-2 & 3, ¼ to 1", 6, 8, 10 M.S. Also 1 to 4" N.S.
LESS 75 Percent Discount.

ADJUSTABLE SNAP GAGES. ALL SIZES. ½ to 8".
LESS 75 Percent Discount.

DE WITT TOOL COMPANY
173 GRAND STREET NEW YORK 13, N. Y.
Send For Our Bargain Circular

EVERY ITEM GUARANTEED AS REPRESENTED

FALK FOR DEPENDABILITY IN REBUILT MACHINERY

AUTOMATICS

2—#00 Brown & Sharpe Full Automatic, Standard Speed

1—1¼" Cone 4-spindle Automatic, Motor Driven, Threading Spindle

1—#515 National Acme 9/16" 4-spindle Automatics, complete

LATHES

10"x24" Logan Q.C.G. Lathes (new)
Sebastian Engine Lathes (new)
13"x6' Williard, geared head
14"x6' Hendey Yoke Head
14"x6' Rockford Cone drive (two)
16"x6' American Motor Driven Lathe
16"x8' Lodge & Shipley 12-speed Grd. Hd.
16" x 8' Monarch Geared Head Lathe
18"x10' American, Geared Head, Taper
20"x10' Hendey with Taper
20"x11' Schumacher-Boye, M.D.
24"x12' LeBlond Heavy Pattern
26"x18' Bridgeford geared head
28"x10' Davis cone driven
32"x16' Bridgeford geared head

TURRET LATHES

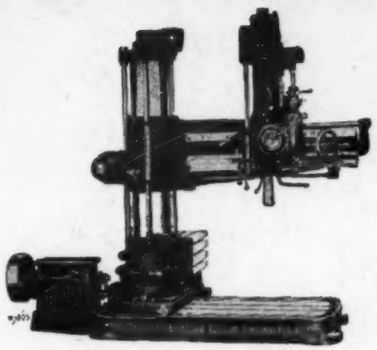
4—#4 Warner & Swasey Hand Screw Machines, arr. Motor Drive
2—#4 Warner & Swasey Universal Turret Lathe, Motor Driven
16" Warner & Swasey Brass Lathe
#2A Warner & Swasey Universal
#3R Gisholt Universal like new
#4 Foster GFH Hand Turret Lathe
3—Morey #2G Geared Head Turret Lathe, motor drive (late model)
2—Simmons #2 (microspeed) Turret Screw Machine (late model)
Bullard 42" Vertical Turret Lathe

TURRET PUNCHES

Hecker, vertical type, 8-station, air operated, 18" throat

PLANERS

20"x20"x24" N.B.P., Planer Shaper
26"x26"x8' Gray Planer, 2 heads



RADIAL DRILLS

3½' Arm, 10" Column Cincinnati-Bickford
4' Arm, 11" Column Cincinnati-Bickford
5' Arm, 13" Column Cincinnati-Bickford
5' Arm, 14" Column Fosdick, motor drive
6' Arm, 15" Column Cincinnati-Bickford

Cincinnati-Bickford 5' Arm, 13" round column with air clamp. Oil grooved, tee slotted base, side base, with plain box table with #5 Morse Taper spindle. Motor drive.

FOUNDRY MOULDING MACHINES

2—#0 Johnston & Jennings, Jolt Squeezer Draw Pattern, 15" x 21" Table

2—#342 Osborn Jolt Rollover Pattern Draw Moulding Machines, 23"x38" table

2—SPO Hand Rollover Power Draw Moulding Machines complete with run-out cars 22½"x60"

SHEARS & METAL WORKING

Lennox Splitting Shear ¾" cap.; 8' throat
Lennox Bevel Shear, ¼" cap.
Peckstow 30"x18 ga. Squaring Shear
Niagara 48" Roller Leveller, 8 Rolls
West Co. 36" x 10 ga. 15" gap, Power Squaring Shear

MILLING MACHINES

#3, #4, #5 Cinn. High Power, Plain, S.P.D.
#1 Brown & Sharpe Plain Miller
P & W 2½" Duplex Spline Miller
Thread Miller, Hall Planetary #1—24"
#8 Lees Bradner Thread Miller
#1, #2 Kempsmith Plain Millers
#3B Hendey Universal Miller, motor drive
#4 Cinn. Vertical High Power Miller. (2)

MISCELLANEOUS

15 KVA Ace Spot Welder, 18" throat
Toledo Spot Welders, 10 K.W., 15 K.W.

GRINDERS

Queen City Dble. End Grinders, new
#33 Abrasive Vertical Surface motor drive
12" No. 22 Heald Rotary Surface Grinder
16" Persons-Arter Rotary Surface Grinder
1—Seybold 96" Knife Grinder
Oliver of Adrian Drill Grinders
Cincinnati Centerless Grinders #2 M.D.
#12 Greenfield Internal Hydromatic Grinder, sizematic type
#2 Brown & Sharpe Surface Grinder
#70 Heald Internal Grinder
#60 Heald Cylinder Grinder
10"x18" Norton Cylindrical
2—Cincinnati, #1½ Tool & Cutter Grinders

BORING MILLS

3½" Bar Landis-Rochester Horizontal Boring Mill, Model #36

#31 Lucas Horizontal Boring Mill, 3" bar

DRILLING MACHINES

Avey, 2 & 3 spindle Prentice, 4 spindle
Henry & Wright, 6 spindle, #2 M. T.
Fosdick 13" Super speed 4-spindle drills
Natco #12, 12 spindle #1 M. T.
2—Natco #14, 22 spindle Rectangular head Drilling Machine, #2 M.T.

POWER PRESS HEADQUARTERS

Famco Arbor & Foot Presses (new)
2—#1A Standard Bench Type Press, ¾" stroke
#4 Bliss D. C. Forging Press
200 ton A.C.F. Hydraulic Press. Bed. 24"x36", 4-post.
Hilles & Jones #4 Single End Punch and Shear. Equipped as Plate Shear with 18" Blades. ARR, motor drive, 48" throat

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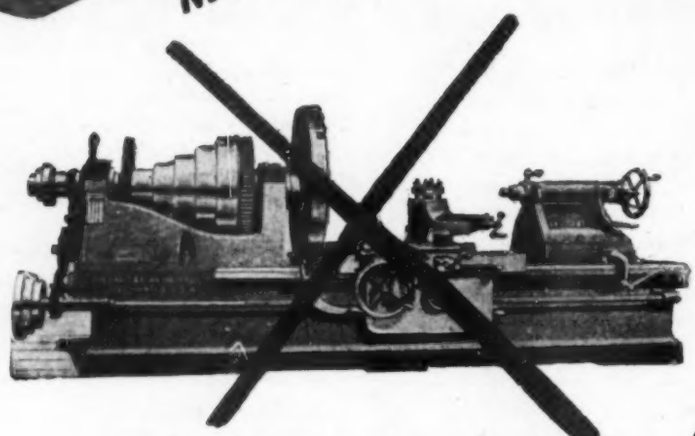
LOW PRICES



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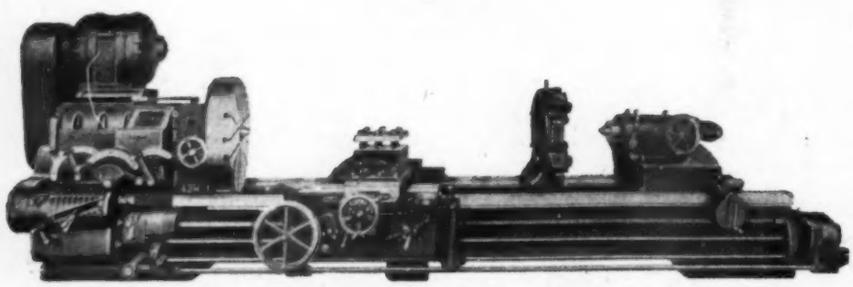

MODERN—LATE TYPE MACHINE

NEARLY

AUTO. SCREW MACHINES

ACME GRIDLEY Model RA-6, 2", Latest Type
BILLINGS & SPENCER B-2 Diametic—Latest
BROWN & SHARPE #4 M.D. Latest Type
CLEVELAND ⅞" to 2¼" Model A
CONOMATICS 3½" 4 spindle—latest type
CONOMATICS 2½"—6 spindle, Latest Type
NATIONAL ACME 9/16" mod. C, 5 spdle., M.D.

BORING MILLS—Horizontal

DETRICK & HARVEY—4" bar—floor type—motor drive
DETRICK & HARVEY—5" bar—floor type—motor drive
FRANKLIN 4½" bar, single pulley drive
LANDIS #35—3¼" bar—floor type
LUCAS #43, 5" bar, Motor Drive
NILES BEMENT POND 5", 6", 7" bar—floor type
NILES BEMENT POND 72" Duplex, 4½" bar, M.D.
OHIO #5F-420 5" bar, floor type, latest type
P & H #10, 3½" bar, floor type, M.D.
SELLERS 5" bar, Table Type, Latest Type
UNIVERSAL #40—4" Bar, Motor Drive
UNIVERSAL #3A—3" bar, Motor Drive
CINCINNATI 24" Duplex, Auto., M.D.
CINCINNATI 24" Plain, Auto., M.D.
CINCINNATI 4-36 Hydromatic, Latest Type
CINCINNATI 28-60 Hydrotel, Vert., Latest Type

BORING MILLS—Vertical

BETTS 120"—2 swivel head, motor drive
BETTS (Consolidated) 100"—2 heads, DC, Latest Type
BETTS (CONSOLIDATED) 84" 3-heads, AC Latest Type
BULLARD 36", New Era Type, M.D.
BULLARD 42" Spiral Drive, latest type
CINCINNATI Hypro 84" 3-heads, AC Latest Type
COLBURN 72" 2 swivel heads, AC, M.D.
KING, 30" Vert., M.D.
KING 36" Motor Drive, Latest Type
NILES 42"—2 swivel heads; power rapid traverse
NILES 73", 2 swivel heads, PRT, AC, M.D.
NILES 100", 2 swivel heads, PRT, M.D.

DRILLS

BAKER #121 Single spindle—latest type
BARNES #H3, Hydram, latest type
BARNES #210—single spindle—latest
BODINE 42-20, 42-30 automatics—M.D.
COLBURN #14, 2 spindle, heavy duty, AC, M.D.
EDLUND #1B, #2B, #2MS, M.D.
FOOTE BURT SIPP #2, #3—single spindle—latest
HENRY & WRIGHT 2 spindle
PRATT & WHITNEY No. ½Bx50" 2 spindle, Deep Hole latest type

MOREY MODERN MACHINERY

DRILLS—Radial

AMERICAN 3½'9"—Maxi-Speed, Motor Drive
AMERICAN 4'11"—5'13" AC, M.D.
AMERICAN 5', Univ., AC, M.D.
AMERICAN 7' Triple-purpose, M.D.
CANDEY OTTO 3'11" New
CARLTON 4'13", 6'15"—M.D.
CINCINNATI BICKFORD 5'13" M.D.
CINCINNATI BICKFORD 6', Univ., AC, M.D.
DRESES 5'13", 4'13" AC, M.D.
DRESES 5'15", Universal, AC, M.D.
FOSDICK 5'14", AC, M.D.
MUELLER 4½'9", 4'11" AC, M.D.
NILES BEMENT POND 6'15" uni., AC, M.D.
RYERSON 4'11", AC, M.D.
WESTERN 3', 4'18", 5'18", 6'20", latest type

GEAR CUTTING EQUIPMENT

BARBER COLMAN Type A Hobber—latest
BARBER COLMAN Type S, #3 #12 Hobber, M.D.
BROWN & SHARPE #3H gear cutter, M.D.
CROSS #73 Univ., tooth-rounder, Latest Type
FELLOWS #7, #7A type, all models, latest
FELLOWS #6, #6A type, all models, latest
GLEASON 11", 18" bevel gear generator, M.D.
GLEASON #13 tester, M.D.
GLEASON 13" Quenching Press
GLEASON 24" Bevel Gear Planer
GOULD & EBERHARDT 12 H.S., Latest Type
HERCULES 24" HOBBER, differential, M.D.
NEWARK #5, 60" Hobber, Latest Type
PRATT & WHITNEY 10" Grinder, hyd.—latest type

DEPENDABLE MACHINE TOOLS • PROMPT SERVICE

ALL BUILT SINCE 1941

GRINDERS—Cyl.—Plain & Uni.

BROWN & SHARPE #1, #2, #3, #4 Univ., motor drive—latest type
BROWN & SHARPE #5 Plain 3x12, 3x18, LATEST
BROWN & SHARPE #20—plain—10x18—Latest Type
LANDIS 6x18, 6x20, plain, M.D.
LANDIS 6"x18" Type C Hyd. Latest Type
NORTON 10x18 Plain—motor drive
NORTON 10x36" Plain Type C, Hyd., latest type
NORTON 16x72 Plain, Type C—latest type
NORTON 16x72 Universal, HYD., Multi-purpose, Latest Type

GRINDERS—Internal Cutters & Miscellaneous

BROWN & SHARPE #10 Tool & Cutter—latest
BROWN & SHARPE #13, Universal Tool, Latest Type
BRYANT No. 16—16" Chucking—Internal—latest
BRYANT #5 internal, hyd., latest type
CINCINNATI #4 centerless, LATEST TYPE
FITCHBURG Uni., spline shaft, hyd.
GLEASON #12 cutter grinder
HEALD 72A3 Sizematic internal, latest type
HEALD 72A5 plain internal, latest type
HEALD #81, Sizematic, Gagematic, Latest Type
OLIVER Tool and Cutter, Latest Type
PRATT & WHITNEY Contour Cutter—latest type
SELLERS #4T Uni., Tool—latest type

GRINDERS—Surface

ARTER 30" Rotary Surface—Hydraulic—latest type
ARTER 8" Automatic Piston Ring
BLANCHARD #16A—Dial Type—motor drive
BLANCHARD #16, 20" Chuck, Motor Drive
BLANCHARD #27-18—42" Chuck—Latest
HEALD #22, 12" Rotary, Latest Type
MATTISON 12x16x48 Hyd., Latest Type
MATTISON 14x16x36 Hyd., Latest Type
MATTISON 14x16x60 Hyd., Latest Type
NORTON 10x36 Hyd., Latest Type

LATHES—Engine & Mfg.

AMERICAN 36x25' centers—Timken Bearing—2 carriages P.R.T. Taper Attachment—Latest Type
BETTS BRIDGEFORD 84x24' bed, AC, M.D.
BRIDGEFORD 36"x28', 36"x32' bed—2 carriages, M.D.
HARDINGE TR59, Motor Drive., Latest Type
HARDINGE 9x54" bed, QCG, Cataract
HENDEY 14"x8' bed geared head
HENDEY 22"x8' bed, geared head
HENDEY—12x54 centers—latest type
HOUSTON, STANWOOD & GAMBLE 36x24' bed
KEIGHLEY LIFTS 8x16x4', Gap, AC, M.D.
LeBLOND 13"x4' bed, Timken Mfg.—latest
LOSWING 4x60, 4x84, 8x60, 8x84, 8x108, Timken Bearing, Latest Type
LOSWING 5x34" Model LR Auto. Timken latest
MOREY MATTHEWS, Shaft Turning, Latest Type
NILES 42"x60", double head, Motor Drive
NILES 48x10' centers—heavy duty—Timken Bearing P.R.T.—Latest Type
NILES 60x10' centers—heavy duty—Timken Bearing P.R.T.—Latest Type
NILES 60x15' centers—heavy duty—Timken Bearing P.R.T.—Latest Type
PITTSBURGH 50'x30' bed—M.D.
REED PRENTICE 24x20' bed, AC, M.D.
RIVETT #918, M.D. Latest Type
RIVETT #608-4-NS, 8x18 centers, M.D.
WARD HAGGAS & SMITH 18x30x10' bed, Gap Lathe, AC, M.D.

LATHES—Turret

BARDONS & OLIVER #5, #7 Timken Bearing—latest type
CINCINNATI ACME #1, #5W, Timken bearing, latest type
GISHOLT #3D Simplimatics—Timken—latest
GISHOLT #2L, #3L, Universal, Timken Bearing, Latest Type
GISHOLT #4L, 9" hole—cross sliding turret—Timken Bearing latest type
GISHOLT #3, Univ., Timken, Latest
JONES & LAMSON #3, #7C Univ., latest type—Timken Bearing
LIBBY #1H-5 Timken Bearing—latest 5½" hole
MOREY 2G, #3, #4, Timken Bearing, latest
WARNER & SWASEY #2, Timken, latest
WARNER & SWASEY #4A—uni. 8" hole, timken bearing, Latest Type
WARNER & SWASEY #3, 4, 5, Universal, Timken Latest

MILLING MACHINES—Mfg.

BRIGGS Type 2A, production, HYD., latest type
BROWN & SHARPE #000—Timken Bearing, Latest Type
BROWN & SHARPE #12 auto., Timken—latest
CINCINNATI 56/90 Hydromatic Latest
CINCINNATI #0-8 Vert.—Pl. Auto.—Timken Bearing—latest type—Rise & Fall
CINCINNATI 48" duplex, automatic, SPD
INGERSOLL 32x24x16', 2 heads, AC, M.D.
KEARNEY & TRECKER #1218 Auto.—Timken Bearing—latest type
MOREY #12M 2 spdle. Profiler & Milling Machine
NICHOLS Hand, M.D.—Latest Type
OHIO Auto. 18"x72" table—Timken Bearing
SUNDSTRAND #3 Rigidmill, AC, M.D.
TAYLOR & FENN M-80, Duplex Spline, Latest Type

MILLING MACHINES—Plain

CINCINNATI #3 High Speed, Dial Type, Timken Bearing, latest type
CINCINNATI #4 Timken Bearing, M.D.
CINCINNATI #4S, #5, high power, M.D.
KEARNEY & TRECKER #3K—Timken—latest
KEARNEY & TRECKER 2HL Timken, Latest
KEMPSMITH #4 Maximiller—Timken—latest

MILLING MACHINES—Univ.

AMES Bench, Timken Bearing, latest type, M.D.
BROWN & SHARPE #3, AC, M.D.
CINCINNATI #2 Motor Drive.
CINCINNATI #2, Dial Type, High Speed, Timken Latest
CINCINNATI #2 Dial Type, medium Speed, Timken Latest
VAN NORMAN 22L, Timken Bearing, Latest Type
HARDINGE Bench, Timken Bearing, Latest Type

MILLING MACHINES—Vertical

BROWN & SHARPE #5—motor drive
CINCINNATI #2 Dial Type—Timken—latest
CINCINNATI #3, #4 High-powered, Motor Drive
CINCINNATI #4, High Speed, Dial Type, Timken, Latest
KEARNEY & TRECKER 2K, 3H, 3K, 4H, 4K, Timken—latest
REED PRENTICE 3VG High-Speed, Latest Type

PLANERS

CHANDLER 36x36x20' 4 heads AC, M.D.
DETRICK & HARVEY 48x48x16', 4 heads, Hyd.
DETRICK & HARVEY 48x48x12 Openside, AC, M.D.
LYND FARQUHAR 26" Openside, motor drive
NBP 54x54x12', 2 heads, box table, AC, M.D.
NILES 48x48x12'—Time Saver—3 heads, P.R.T., box table, DC, M.D.—latest type
NILES 48x48x16', 4 heads, AC, M.D.
OHIO 42x42x20'—2 heads, AC
POND 48x48x16' 2 heads, AC, M.D.

SAWS

BRIDGEPORT #48W Abrasive
ESPEN LUCAS #138—Cold Saw, M.D.
GROB OS-20—band and filing—Latest Type
NEWTON #504, cap. 12½" Rd., M.D.
NEWTON #506, cap. 16¾" Rd., M.D.
NEWTON #508, cap. 22" Rd., M.D.
PEERLESS 14x14 Hack; latest type

SHAPERS

CINCINNATI 24" Crank—Motor drive
CINCINNATI 26" Travel Head—2 head Type B
COCHRANE BLY Univ. Vert. Shaper-Miller, M.D.
LAMAIRE 18' Vert. Hydraulic—latest type
NILES 18" ver. slotter, DC, M.D.
MOREY 8", 10", 12", 14", Vertical Latest type
NEWTON 15" ver. slotter, D, M.D.
ORMEROD 8" Vertical, M.D.
PRATT & WHITNEY 6', 10" Vertical, Motor Drive

THREAD MILLING MACHINES

HALL—Planetary, M.D.—Latest Type
HANSON & WHITNEY 4x9, Latest Type
MOREY SHIELDS 12x120, 12x192—latest type
PRATT & WHITNEY 4½x12, Model "C"—Latest
PRATT & WHITNEY 6x132—Motor Drive
PRATT & WHITNEY 6x20 Model "C"—Latest
SMALLEY General #20 MB, Motor Drive

MISCELLANEOUS

BARNES #420 2-spindle deep hole Drill—Hyd.—Latest Type
BAUSH Radial Tapper—latest
CASCADE #120 Industrial deep freeze
FERRACUTE No. DG55, Drawing, latest type
GENERAL ELECTRIC 100 KW Generator
LaPOINTE #3L Broach, horiz. hyd. 15 ton cap.
LeBLOND #2 deep hole borer, latest type
MORTON 60" combination travelling head planer, milling and drilling, motor drive.
NILES 30"x50' deep hole borer, Timken—latest
PRATT & WHITNEY 3-B Jig Borer—Latest type
SHUSTER #1 Wire Straightener
TREADWELL 12"—Pipe Threader—Motor Drive
WHITON 8x108 centers duplex centering, M.D.
YATES AMERICAN J-70, Woodworking Lathe, latest
YODER Multiple tube cutting machine—latest

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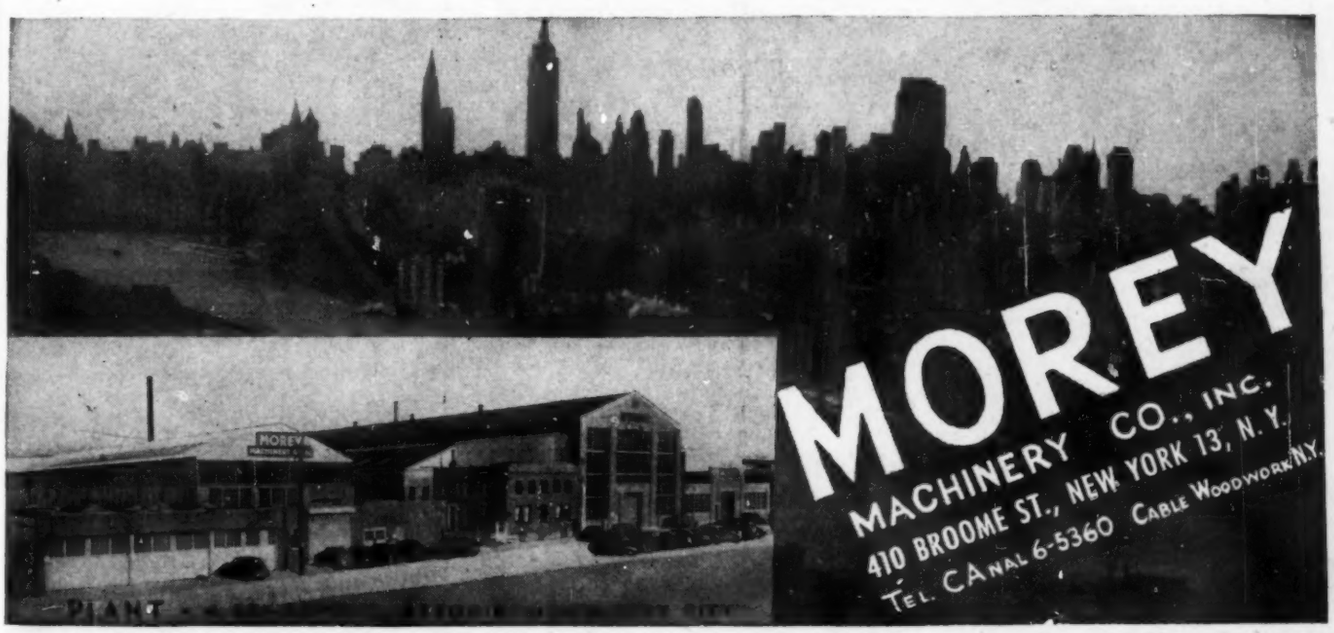
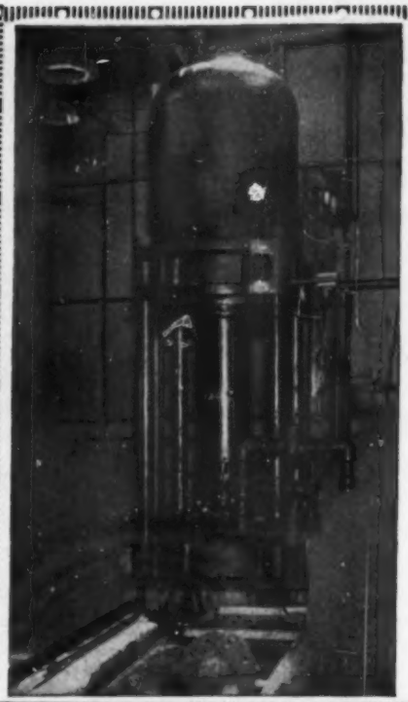


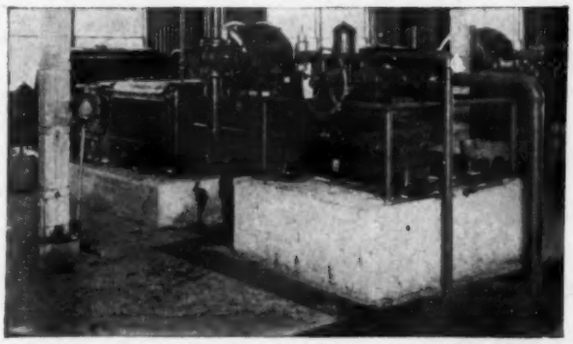


5 WORTHINGTON HYDRAULIC PUMPS

Horizontal Duplex, double acting, water as hydraulic fluid, 3500 P.S.I. discharge pressure. Crank shaft speed 80 R.P.M. Plunge speed 240 F.P.M. Hydraulic H.P. 272 B.H.P. Mechanical Efficiency 90%. H.P. 302. Flexibly coupled to 300 H.P., 3 ph. 60 cy. 2300 V, 600 R.P.M., Slip Ring Wsghse. motor type C.W., with magnetic controllers and primary oil circuit breaker.

1 Watson Stillman High Pressure Hydraulic Accumulator

Bulletin C.27. Air Cylinder, 42" dia., Hydraulic ram 11½" dia., stroke 50". Hydraulic pressure 3500 P.S.I., Ram displacement 21.5 gallons. Excellent condition, new 1942.



1 WATSON STILLMAN HYDRAULIC ACCUMULATOR

Heat and Power Co., inc.

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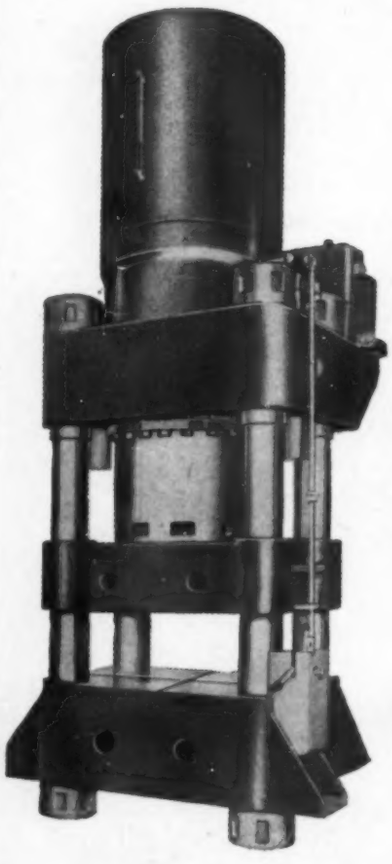

1300 TON WATSON STILLMAN HYDRAULIC PRESS Self Contained

Platen size 48"x42". Stroke 22". Opening 37. Ram Diameter 35". Driven by 50 H.P. Motor, *Also*

600 TON ELMES PRESS

Self contained 48x45" between rods, 36" stroke, 66" openings, 75 H.P. motor, 3 phase, 60 cycle, 220v.

1320 TON PRESS, SELF CONTAINED

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- #4K Kearney & Trecker Plain Miller
- #4HS Cincinnati Plain Miller
- #3HS Cincinnati Vertical Miller
- #1-18 Cincinnati Plain Miller
- #2LS Lapointe Hydraulic Broaching Machine
- 16" x 72" Norton "C" Plain Grinder
- 6" x 30" Norton "C" Plain Grinder
- #3 and #4 Warner & Swasey Turret Lathes
- #1 Brown & Sharpe Wire Feed Screw Machines
- #3 Allen 2-spdl. Drill #4 MT

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TURRET LATHES AND SCREW MACHINES

No. 1A Warner & Swasey Universal, m.d., pre-selector, cross sliding turret, bar feed, m.d., latest type
No. 1 Cincinnati-Acme Semi-Universal, m.d.
No. 1L Gisholt Universal, m.d., chucking
No. 1A Warner & Swasey, m.d., chucking
No. 2 Cincinnati-Acme Full Universal, m.d., chucking, Timken, latest
No. 2B Foster Universal, m.d., chucking
No. 2L Gisholt Universal, m.d., chucking
No. 2G Morey Ram Type, m.d. in base, bar
No. 2 Pratt & Whitney Shaver, m.d.
No. 2A Warner & Swasey Universal, m.d., chucking, pre-selector head, latest
No. 2A Warner & Swasey Universal, m.d., bar, pre-selector head, latest
No. 2A Warner & Swasey Universal, m.d., bar
No. 2A Warner & Swasey Universal, m.d., chucking
No. 3 Cincinnati-Acme Full Universal, m.d., chucking
No. 3 Foster Geared Head, m.d., bar
No. 3B Foster Universal, m.d., bar, taper attach.
No. 3 Warner & Swasey Universal, m.d., bar, latest
No. 3S Cincinnati-Acme, m.d., bar, Timken, latest type
No. 3L Gisholt H.D., m.d., chucking, Timken
No. 3A Warner & Swasey Universal, m.d., bar
No. 3A Warner & Swasey, m.d., chucking
No. 3A Warner & Swasey, m.d., bar, latest type
No. 4R Cincinnati Acme, m.d., bar
No. 4 Gisholt Universal, m.d., chucking
No. 4 Warner & Swasey Universal, m.d., bar, pre-selector head, latest
No. 4 Warner & Swasey Universal, m.d., chucking, pre-selector head, latest
No. 4 Warner & Swasey Universal, m.d., older type
No. 4A Warner & Swasey Universal, m.d., chucking, Timken
No. 5 Jones & Lamson Universal Ram Type, m.d., latest
No. 7 Bardons & Oliver Universal, motor built in head, latest
2½" Jones & Lamson Universal Saddle Type, m.d., bar, latest
2½x24" Jones & Lamson Geared Head, m.d., bar
2 spindle 3x36" Jones & Lamson Geared Head, m.d., chucking
3x36" Jones & Lamson, m.d., bar
3¼" Cincinnati Acme Geared Head Flat Turret, m.d., chucking
3½x32" Jones & Lamson, m.d., bar
3½x32" Jones & Lamson, m.d., chucking
18" Libby Type A Turret, m.d., chucking
24" Gisholt, cone
26" Libby Type C Turret, m.d., chucking

ROLLS

No. 4 Hilles & Jones Straightening Rolls, cap. 8'x8" plate

GEAR MACHINERY

Type A Barber-Colman Gear Hobber, m.d.
No. 12 Barber-Colman Double Overarm, long bed, m.d.
Type T Barber-Colman, m.d.
No. 3 Precision Barber-Colman, m.d.
No. 3 Barber-Colman, m.d.
3" Gleason Straight Bevel Gear Generator, m.d.
8" Gleason Mfg. Type Straight Bevel, m.d.
12" Gleason Straight Bevel, m.d.
9" Pratt & Whitney Hydraulic Spur Gear Grinder, m.d.
10" Pratt & Whitney Hydraulic Spur & Helical Gear Grinder, m.d.
11" Gleason Straight Bevel, m.d.
No. 2HS Lees-Bradner Spur & Helical Gear Grinder, m.d.
No. 13LS Fellows Gear Lapper, m.d.
No. 34 Brown & Sharpe Gear Hobber, m.d.
No. 44 Brown & Sharpe Gear Hobber, m.d.
48" Cleveland Gear Hobber, m.d.
No. 6—60" Brown & Sharpe Gear Cutter, m.d.
No. 6 and 61 Fellows Gear Shapers, belt
No. 7A, 715A Fellows Gear Shapers, m.d.
No. 18 Fellows Gear Finishing Machine, m.d.
No. 61A, 64S, 615A, 645A3 Fellows Gear Shapers, m.d., latest type
Cincinnati Gear Burnisher, m.d.
No. 96H Gould & Eberhardt Gear Hobber, m.d.

CENTERLESS GRINDERS

No. 2 Cincinnati, m.d., new, latest
No. 3 Cincinnati, m.d., new, latest
No. 2 Cincinnati, m.d., latest
No. 2 Cincinnati, m.d., older type
Cincinnati Valve Seat Grinder, m.d., cap. ⅜" valve stems

CYLINDER GRINDERS

No. 50 Heald Hydraulic, m.d., new latest type
No. 55 Heald, m.d.
No. 73 Heald Airplane Cylinder, m.d., new, latest type
No. 65 Heald, belt
No. 6 Landis, belt

SURFACE GRINDERS

14" Pratt & Whitney Vertical, m.d.
22" Pratt & Whitney Vertical Type B, m.d.
Builders Iron Foundry Surface, m.d.
No. 10 Blanchard Vertical, m.d., 16" rotary chuck
No. 11 Blanchard, m.d., 16" rotary chuck, latest
No. 16 Blanchard, m.d., 26" chuck
No. 18 Blanchard, m.d., 30" chuck, latest
No. 33 Abrasive Vertical, 18"x6" chuck
16" Arter Model A3 Rotary, 16" chuck, new
No. 25A—16" Heald Rotary, m.d., latest
No. 25A-24 Heald Rotary, m.d., latest

INTERNAL GRINDERS

No. 172 Heald Gap Grinder, m.d., new
No. 72A5 Heald, m.d., latest
No. 72A3 Heald Sizematic, m.d.
No. 72A Heald Plain, m.d.
No. 72A3 Heald Gagematic, m.d.
No. 73 Heald Airplane Cylinder, m.d., new
No. 74 Heald, m.d.
No. 6, 10, 20 Bryant, belt
No. 9 Cincinnati, belt
No. 16A—16" Bryant, m.d., latest
No. 16A—22" Bryant, m.d., latest
No. 16RS Bryant, m.d.
No. 24—21" Bryant, m.d.
No. 49 Heald Single End Boremetic, m.d.

PLAIN CYLINDRICAL GRINDERS

3x18" No. 5 Brown & Sharpe, m.d., latest
6x18" Cincinnati Hydraulic, m.d.
No. 10 Brown & Sharpe Self-Contained, m.d.
No. 11 Brown & Sharpe Self-Contained, m.d.
6x18" Landis Self-Contained, m.d.
6x32" Fitchburg Type A, m.d., latest
8x36" Cincinnati Saddle Type, m.d.
10x24" Landis Self-Contained, m.d.
10x36" Cincinnati Hydraulic model EA, m.d.
10x48" Brown & Sharpe, belt
10x48" Landis Type C Hydraulic, m.d., latest
10x72" No. 16 Brown & Sharpe, belt
10x72" Landis Self-Contained, m.d.
12x36" Landis S.C., m.d.
12x48" Cincinnati S.C., m.d.
12x96" Landis S.C., m.d.
14x18" Cincinnati S.C., m.d.
14x48" Cincinnati S.C., m.d.
14x52" Norton motorized
14x72" Cincinnati S.C., m.d.
16x72" Landis S.C., m.d.
20x120" Landis S.C., m.d., with gap
26x96" Landis S.C., m.d.

RADIAL DRILLS

3' Fosdick, gear box
3' Cincinnati-Bickford, gear box
3' American Triple Purpose, m.d. on arm, 11" col.
3' American Sensitive, belt
3' Fosdick Sensitive, belt
4'-11" American Triple Purpose, gear box
4'-13" Cincinnati-Bickford Super-Service, m.d. on arm
4'-13" Cincinnati-Bickford, gear box
4'-13" Carlton, m.d. on base
4' Niles-Bement-Pond Semi-Universal, m.d.
5' American Triple Geared, gear box
5' Cincinnati-Bickford Plate Hole Driller, m.d.
5' Prentice Plain, m.d.
6' American Triple Purpose, m.d. on base
6'-15" Carlton, gear box on base
6'-15" Cincinnati-Bickford Super-Service, m.d. on arm
6' extended to 7' Cincinnati-Bickford, m.d. on base
6' Niles-Bement-Pond Semi-Universal, m.d.
6'-16" Western, m.d.
8'-16" American Triple Purpose, m.d. on arm
8'-16" American Triple Purpose, m.d. on base
10'-22" American Triple Purpose, m.d. on arm

HORIZONTAL DRILLS

No. 1 Pratt & Whitney 2 spindle Deep Hole, m.d.
No. 1B—50" Pratt & Whitney Deep Hole, m.d., latest
No. 1½ Pratt & Whitney 2 spindle Deep Hole, m.d.
No. 1½x105" Pratt & Whitney 2 spindle Deep Hole, m.d., latest
Snyder Tool Co. Double End Boring Machine, m.d.
Pratt & Whitney Rifling Machine, belt
No. 420—2 spindle W. F. & John Barnes Deep Hole, m.d., latest
5 spindle Detroit Semi-Automatic, belt
No. ½Bx50" Pratt & Whitney Chambering Machine, m.d.

UPRIGHT DRILLS

24" Cincinnati-Bickford, m.d.
28" Cincinnati-Bickford, belt
30" Rich H.D., m.d.
32" Aurora, belt
H3 Barnes Hydram, m.d.
D4 Colburn H.D., m.d.
D8 Colburn H.D., s.p.d.
No. 25 Foote-Burt H.D., s.p.d.
No. 36 HO Baker H.D., m.d., latest

VERTICAL BORING MILLS

24" Bullard New Era, m.d., with side head
24" Bullard Spiral Drive, m.d., with side head, taper
24" Bullard Spiral Drive, m.d., with side head, threading attach.
36" Bullard New Era, m.d., with side head
36" Bullard Spiral Drive, m.d., with side head
42" Bullard New Era, m.d., with side head
42" Colburn H.D., m.d., 2 swivel heads
48" Cincinnati Rapid Production, m.d., 1 turret, 1 swivel head
48" Putnam H.D., m.d., 2 heads
53" Niles, m.d., 2 heads
54" Colburn, m.d., 1 turret, 1 swivel head
72" Cincinnati, m.d., 2 heads
84" Niles H.D., m.d., 2 heads
100" Niles H.D., m.d., 2 heads

BROACHING MACHINES

No. 75 H.P. LaPointe Horizontal Hydraulic, stroke 150", cap. 37½ tons normal, latest type
Colonial VAS-5-42 Vertical Hydraulic, m.d., latest
No. 4 LaPointe of Hudson, gear box
Cincinnati Mill Broach, 10" spindle, new

BALL BEARING DRILLS

No. ½ Avey, m.d.
No. 1B Edlund, m.d., new
No. 2 Avey, m.d.
No. 5M—16" Fosdick
No. 2 Leland & Gifford Hydraulic, m.d., latest
No. 3 Motor Avey, latest
2 and 4 spindle Aveys, belted m.d.
4 spindle Motor Avey, latest
4 spindle Delta, m.d., latest
4 spindle No. 2 LMS Leland & Gifford, m.d., latest
6 spindle No. 3 Avey MA6, latest

MULTIPLE SPINDLE DRILLS

No. 3 Baush, m.d., 15 spindles
3 spindle 12" Rockford Gang, m.d.
4 spindle Foote-Burt Rail, m.d.
No. 16 Fixed Center Foote-Burt, m.d.

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THE EASTERN MACHINERY COMPANY
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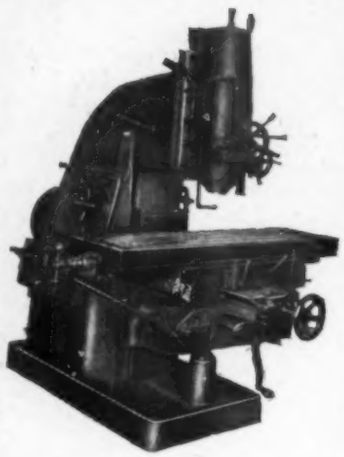
Immense Stocks...Quick Delivery! BOTWINIK Machine Tools

Cincinnati No. 3 Vertical Miller



Has dual controls. Table overall 16½" x 60". Table working surface 16½" x 56". Long power 34", cross power 14½", vertical power 14". 3 T slots in table ¾". Feeds per minute ½ to 20. Spindle taper #50 U.S. Standard. 16 spindle speeds 15 to 414 RPM. Throat dist. 18", maximum dist. end of spindle to top of table 22". Spindle feed, vertical power .005" to .027". Floor space 92" x 110". Approximate weight 7590 lbs.

DRILLS

Avey & Allen 3, 4, 5, & 6 Sp.
Cincinnati-Bickford 3', 4', 5', & 6' Radials

GRINDERS

Abrasive Nos. 33 & 34; No. 3B
Gardner & Besly 53" Horizontal Disc
Norton 6"x18" Hyd. Surface
Norton 6"x10"x36" Surface
Norton 15"x15"x72" Surface
Norton 6x32, 10x24, 10x50 Plain
B. & S. Nos. 10, 11, Plain
Bryant Nos. 3B, 5, 6, 12 Internal
Heald No. 70-A, Internal
Landis 12"x32"
Cincinnati No. 1½ Tool & Cutter
LeBlond No. 2 Tool & Cutter
Norton No. 2 Tool & Cutter
Cincinnati No. 2 & No. 3 Centerless
Cincinnati No. 3 Centerless Lapper
Fitchburg 36" Spline Grinder
Blanchard No. 16—30"
Heald No. 25—A Rotary Surface
P. & W. 14" Vert. B.B.
P. & W. 22" Vertical, B.B.

LATHES

Hendey 14"x6' Y.H. Fact. M.D.
American 16"x6'—G.H.
Lodge & Shipley 20"x8' G.H.

MILLERS

K & T #2HL Plain
K&T—3K Plain
Milw. No. 2B & 3B Double Overarm
B. & S. No. 0Y Production
Cin. No. 2MH Plain; Nos. 3, 4 Vert.
Becker Model C, Vertical
B. & S. No. 3B & 5B Plain
Van Norman #2, #20
Rice-Barton 4" Spline
P. & W. 8", 10", & 12" Automatic
Cincinnati 18" & 24" Production
Sundstrand No. 1-18 and No. 2 Electromil.
P. & W. 6x14 & 6x72 Thread
Lees-Bradner 6"x36" Thread
Van Norman Duplex Nos. 0-2-20
Van Norman #2 Plain
Cincinnati #5 M.D. Plain
K&T #2K, 3K Vertical

PLANERS

Cincinnati—48"x48"x20' 3 Head

SCREW MACHINES

B. & S. No. 00, 0, 2 Automatics
B. & S. No. 1 & 2 Hand Screw
Potter & Johnson No. 6-C Chuckers
Cleveland 1¾" Model AA
W. & S. Nos. 1, 2, 2A, 3A Universal
Foster No. 7 and No. 1B
Cone 1¼" 4 Spindle
Cleveland 3¾" Model A, Latest Type
Cone 3½"—4 Spindle
Cleveland 6¾" Model A
Cleveland 7¾" & 8" Model A
Gridley ⅞", 1¼", 1¾", & 2⅝", Model G; 3¼" & 4¼"

MISCELLANEOUS

Bore matic—Heald No. 47-A
Boring Mill—Gisholt 30"
Boring Mill—Bullard 36" & 42" New Era
Boring Mill—Bullard 100" 2 Head.
Fay Automatic
Fellows Gear Shaper No. 7
Hammers—Bradley
Rack Shaper—Fellows 4"x72"

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3'9" Cine-Bickford—Radial, Mtr. on arm—1942 Mfg.
3'9" Avey Sensitive Radial
16" Sipp—4 spindle—T&L Dr.
16" Allen—4 spindle—T&L Dr.
Natco D5 Multiple—Mtr. Dr.
16" Can.-Otto Floor & Bench—110/1/60—NEW
21" Can.-Otto—BG—Upr—Sl. Head—NEW

GRINDERS

6x18 Monarch Surface—Hand—Mtr. spdle
14x14x48 Abrasive Surface—Mtr. Dr.
#2 Cincinnati Centerless—Filmatic—1942 Mfg.
#25 Heald Rotary Surface—M.D.

LATHES AND TURRETS

14"x6' South Bend QCG—Precision—Mtr. Dr.—1941 Mfg.
16"x54" Reed-Prentice—18 speed—Mtr. Dr.—1941 Mfg.
16/20x58" Lodge & Shipley—Sel. Head—Mtr. Dr.—1941 Mfg.
16"x6' Sebastian 8-speed—Mtr. Dr.—NEW
16"x6' Lodge & Shipley—4-speed Mtr. Dr. QCG
36"x15' American QCG—Belt Dr.
10"x24" Logan Bench and Floor—NEW
#3 & #5 Jones & Lamson Univ. Turret—1942 Mfg.
#2 Warner & Swasey—4 Sp. Drive—M.D.

MILLING MACHINES

#2A B & S Double Overarm—Universal—Mtr. Dr.—Vert. Attach.
#2M Cine. Plain Horiz.—Mtr. Dr.—Vert. Attach.
#2S Van Norman—Plain Horiz. PRT—1942 Mfg.
#2K K & T "Milwaukee" Plain Horiz.—Vert. Hd.—1942 Mfg.
#2G Kempsmith Universal—Div. Hds.—1943 Mfg.
#2MH Cine.—Plain Horiz.—PRT—1942 Mfg.
#2 Cine.—Universal—4 spd—Mtr. Dr.—Div. Hds.
#3 Garvin Universal—Mtr. Dr.—Vert. Attach.—Div. Hds.
#3 Cine.—Plain Horiz.—PRT—1942 Mfg.
#3 Ohio Universal—Belt Drive
Nichols Hand—Mtr. Dr.—1942 Mfg.
Miller & Crown. Hand—Mtr. Dr.—1941 Mfg.

PRESSES

12-ton U. S. #1 Incl.—MD—NEW
5-ton Perkins Incl.—MD—NEW
#3K Perkins Screw—NEW
#10 & 12 Famco Foot—NEW
#2 & 3 Arbor—NEW

SAWS

#4B Cochran-Bly Cold
6x6 L-W Toledo Hack—MD—NEW
8x10 Kalamazoo—MD—Metal Band—NEW

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New Since 1941
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5—#3 Warner & Swasey Universal Geared Head Turret Lathes
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2—#5 Warner & Swasey Universal Geared Head Turret Lathes
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New No. 2 MJ Cincinnati Universal Milling Machine, Motor 3/60/220-440 volts, Index Head with raising blocks, chuck, vise, arbors, adapters, reducing collets and 28 milling cutters. Immediate Stock Shipment.

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54", 60" and 72" COLBURNS, two heads.
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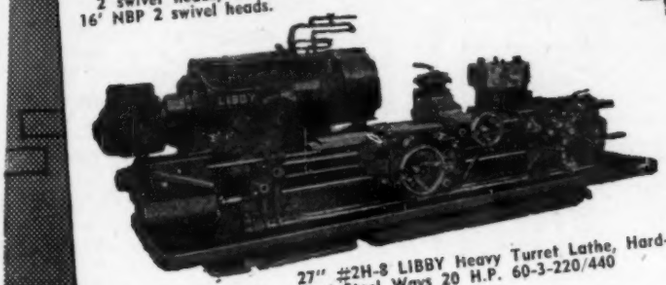
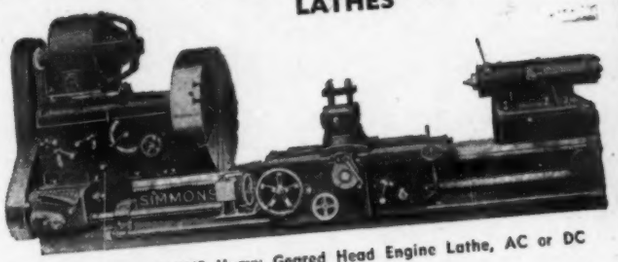
2 swivel heads, all geared feeds.
16' NBP 2 swivel heads.



27" #2H-8 LIBBY Heavy Turret Lathe, Hardened Steel Ways 20 H.P. 60-3-220/440

LATHES



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⅜"-16	.50 "
⅜"-24	.50 "
7/16"-14	.50 "
7/16"-20	.50 "
½"-13	.75 "
½"-20	.75 "
9/16"-12	.75 "
9/16"-18	.75 "
⅝"-11	1.00 "
⅝"-18	1.00 "
¾"-10	1.50 "
¾"-16	1.50 "
⅞"-9	2.00 "
⅞"-14	2.00 "
1"-8	3.00 "
1"-14	3.00 "
1⅛"-7	5.00 "
1⅛"-12	5.00 "
1¼"-7	5.00 "
1¼"-12	5.00 "
1⅜"-6	5.00 "
1⅜"-12	5.00 "
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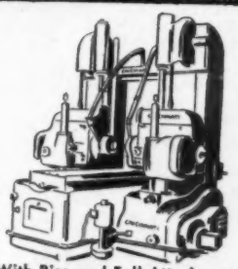

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Max. Width, Spindle to Spindle . . . . 28"
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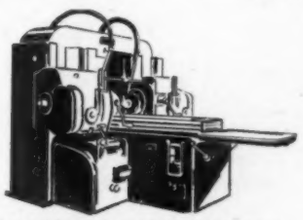

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12"x21" Fay Automatic
12"x18" Lipe Carbo, M.D.
18"x6' American Grd. Hd.
18"x48" Monarch, Keller attachment (1942)
22"x48" Monarch, (1943)
36"x30' Lodge & Shipley Triple Geared Selective Head, two carriages
42"x11' cc American
42"x18' Putnam Geared Head
42"x30' American Grd. Hd.
50"x17' cc LeBlond
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No. 2H Milwaukee Vertical (1942)
No. 2 Cincinati Med. Spd. Vertical (1942)
No. 3 Cincinnati Vertical
No. 3 Milwaukee Vertical M.D.
No. 3K Milwaukee Vertical
No. 2K Milwaukee Plain (1941)
No. 4 Cincinnati Med. Spd. Plain (1941)
No. 4 Cincinnati Plain, Motor Drive
No. 118 Van Norman Production
24" Cincinnati Production
Taylor & Fenn Spline
No. 27MB Smalley General Thread
No. 2 Hanson-Whitney Thread
No. 6 Lees-Bradner Thread
24"x24"x12' Ingersoll Adjustable Rail
26"x25"x12' Ingersoll Adjustable Rail

DRILLS

D-8 Colburn Hvy. Duty No. 6 M.T.
No. 2-8 Spdl. Leland-Gifford (1942)
3 Morris Mor-Speed Radial, 11" Col. (1943)
4' Cinn-Bickford, 9" Col. (1942)
7' American full Universal Radial
7' Carlton, Motor on arm
7' American Hole Wizard, 17" Col. (1943)

VERT. BOR. MILLS

34" King
42" Bullard New Era Vertical Turret
72" Cincinnati
72" Niles Extra Heavy

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No. 31—3" Bar Lucas
3½" Bar Cinn.-Gilbert, Table Type (1942)
No. 25-C, 3¾" Bar Defiance, Table Type (1942)
No. 360-F Giddings & Lewis (1942)
No. 560-F Giddings & Lewis (1942)

GEAR MACHINES

No. 3 Barber Colman
No. 7 Fellows Gear Shaper
12" Michigan Gear Shaver

PLANERS

36"x36"x8' Woodward & Powell

TURRET LATHES

No. 2 American Brass Lathe, M.D.
No. 2 Brown & Sharpe, Wire Feed
No. 3 W & S, Bar Fd. (1940)
No. 1-A W & S Univ. Speed Selector (1941)
18" Libby—3½" Hole—M.D.

GRINDERS

12"x72" Colonial Broach Grd.
No. 22—12" Heald Rotary Surface
No. 34 Abrasive surface
10"x24" Landis Universal, M.D.
12"x36" Landis Universal (1945)
10"x72" Colonial Broach Grdr.
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Norton Motor Driven Grinders practically all sizes 6x18 to 24x240.

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PRESSES

1—Farquhar 100 Ton Hydraulic Press—Daylight 48", stroke 36", approach and return speed 1600' per min.—given max. variation 15%, wght. 44,000 lbs. elect. equip. 440/3/60. (Condition equal to new.)

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1—Niles #72 Duplex control, Horiz., M.D., 4½" bar.

1—Lucas #31 Precision Hor. Bor. Mill, M.D., tbl. 24"x48", spin. diam. 3", dist. from spin nose to face of tailstock 60".

1—Lucas #43 Precision Hor. Bor. Mill, M.D., tbl. 36"x72", spin. diam. 4½", dist. from spin. nose to face of tailstock 84".

VERTICAL BORING MILLS

Bullard 24", 36" New Era Type, and (2) 36" and (1) 54" "Spiral Drive," Vert. Bor. Mills.
1—14' Sellers, 2 heads, on cross rail, elect. equip.

MILLERS

1—B. & S. 1½A Univ. Miller, tbl. wkg. surf. 36½"x8½", power feed: long. 20", trans. feed 7", vert. 18".
1—B. & S. 2A Univ. Miller, dbl. overarm, motor in base, tbl. wkg. surf. 45"x11½", power feed: long. 28", cross 10", vert. 18".
1—Van Norman #2 Duplex Miller, tbl. wkg. surf. 41⅞"x9¾", power long. feed. 28", cross 11", vert. 18".

1—Van Norman #3 Duplex Miller, high speed mill. attmt., 12 speeds, tbl. wkg. surf. 48¼"x10", power feed: long. 32", cross 12", vert. 18⅞". B. & S. No. 2 light type, Pl. Hor. Miller, very latest type.

2—Van Norman #3S. Pl. Hor. Miller Machines. (Very latest type) tbl. wkg. surf. 64"x14", all power feeds, long. 34", cross 12", vert. 17".
2—Milwaukee No. 2K Pl. Horiz. Miller, with vert. hed., very latest type.

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Monarch Lathe, 30" swing x 54" centers, complete with chuck, etc.

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No. 4½ BLISS, 80-100 Ton Capacity straight side punch press, late model with scrap cutters, double roll feeds, bolster. 10 H.P. motors and controls, forced feed lubrication. 21x27 bolster 4½" stroke. In both Single and Double Action Models. Like new.

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35 ton Bliss Gap Frame Punch Presses, 4-8" stroke, latest design.

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Complete with starting panel, consisting of G.E. motorstarter switch, push button control, square "D" Switch, and capacitator. Purchased new 3½ years ago. Excellent condition. *Available for immediate delivery.*

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SMALLEY GENERAL THREAD MILLERS, 24" swing 36" centers. (15)
FOOTE-BURT VERT. 9 sp. Hyd. Drills, #4 & #5 MT, Rotary Table (5)—Crank Balancing Machine
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Milwaukee Model M-24 Simplex Mfg. Milling Machine
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Lees Bradner Model 40 Thread Millers
32"x14' Engine Lathe
36"x14' Ingersoll Slab Miller

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30,000 H.S. Drills, Long length, core, taper and straight shanks, also plastic drills—patented.

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40,000 Milling Cutters—Saws, Counter borers, Sinks, End mills, etc.

25,000 H.S. Taps all sizes in N.F. and N.C. also Nibs.

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12" x 16" x 36" Mattison High Powered Surface Grinder
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2—14" x 16" x 60" Mattison High Powered Surface Grinder
16" x 16" x 48" Thompson Type C Hydraulic Surface Grinder

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Bridgeport 5 Conn.

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(3) Practically New (1943) Model #49 New Britain Gridley four-spindle Chucking Machines, Chuck Vise 9".

ORIGINAL COST OF $15,000 each.

Our Price for quick removal . . . $1750.00

Machines absolutely equal to new. Can be inspected in our warehouse.

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1—#2G 1—#0G 1—00
1—#2 1—#0 1—19
2—#16A Gorton Swiss Automatic Screw Machines.
4—Bechler Swiss Automatic Screw Machines.
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Machines are all motorized and can be seen in operation.

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No. 2 and No. 3 Cincinnati Centerless Grinders, with Hydraulic Profile Wheel truing attachment, through feed rest, Filmatic bearings, motor driven. New in 1942.

2⅝" RA-6 Acme Gridley Automatic Screw Machine, with bar feed rack collets, chip conveyor, motor and control. New in 1943.

AUTOMATICS
★ **9/16" RA-6 Acme-Gridley Automatic Screw Machines. Bar equipment. New in 1943.**
1¼"—8 spindle Cone Automatic Screw Machine. New in 1942.
5½" Cleveland Model A, single spindle.
16⅝ x 33" Fay Automatic Lathe.
⅞" Cleveland Model M, four spindle.

BORING MILLS
No. 31 Lucas Horizontal, m.d.

BROACHES
LaPointe CPC 24, Hyd., Vertical. New in 1945.
★ **H-15-60 American Horizontal Hydraulic Broaching Machine, 15 ton capacity, 60" stroke, with 20 HP motor and control. New in 1942.**

DRILLS
4' Canedy-Otto Radial Drill. New in 1946.
No. D2 Colburn, single spindle.
No. 314 Baker, single spindle.
42" Cincinnati-Bickford.
★ **No. 2LMS Leland Gifford Single spindle drill, with hand-hydraulic spindle feed, motor driven. New in 1943.**
★ **No. 3 Baush Multiple Drill, 20 spindle, No. 2 Morse taper, rectangular head 20" x 40".**

GEAR CUTTERS
★ **No. 3616 Cleveland Hobbing Machine, capacity 60" diameter x 16" face, motor driven. New in 1943.**
No. 3 and No. 12 Barber-Colman Gear Hobbers.
No. 61 Fellows Gear Shaper, m.d.
No. 715 Fellows Gear Shaper, m.d.
6" Gleason Str. Bevel Gear Generator.

GRINDERS
No. 22 Heald Rotary Surface Grinder.
No. 16-26" Blanchard Surface Grinder.
No. 72A3 Heald Sizematic Intern. Grndr.
No. 72A3 Heald Gagematic Intern. Grndr.
6 x18 Cincinnati Cylindrical. New in 1943.
10 x 36 Norton Cylindrical. New in 1942.
No. 3 Brown & Sharpe Universal Grndr.
No. 13 Brown & Sharpe Universal & Tool.
★ **Model B Thompson Hydraulic Surface Grinder, 10" x 24" capacity. New in 1942.**
No. 35 Excello Thread Grinder. New '43.
No. 5-VRO Hammond Buffer. New 1943.

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12" x 30" Pratt & Whitney, g.h.
14" x 6' Sebastian, motor in base.
16" x 6' Hendey, g.h.
18" x 12' Lodge & Shipley, g.h.
24" x 72" LeBlonde, motor driven. New in 1942.
48" x 12' Lodge & Shipley, c.d.
IMP and LR LO-Swing Lathe, m.d.
15" x 30" Lipe Carbo-matic. New in 1943.
17" x 50" LeBlonde Production, m.d. New in 1942.

LATHES, TURRET
No. 4A Warner & Swasey, g.h. New '42.
No. 3A Warner & Swasey, g.h.
No. 1A Warner & Swasey, g.h. New '43.
No. 4 Gisholt, Univrsl., g.h. New in 1943.
No. 3 Warner & Swasey, g.h. New 1943.
No. 1 Bardons & Oliver, c.d.
No. 1 Brown & Sharpe, m.d.
No. 6D Potter & Johnston.
36", 42" Bullard VTL, New Era.

MILLS
No. 3 Cincinnati Universal, motor in base, rectangular overarm.
No. 2 Cincinnati Universal, motor in base, rectangular overarm.
No. 4 K & T Milwaukee Plain. New in 1942.
No. 2H Milwaukee Plain double overarm, motor in base.
No. 2 MH Cincinnati Plain, m.d.
No. 2 H Milwaukee Vert., motor in base.
No. 4 Cin. Vert., dial type. New in 1943.
No. 2209 Milwaukee Mill, table 22"x158".
No. 3-36"Cinci. Hydromatic Duplex, m.d.
No. 56-72" Cinci. Hyd. Duplex Milling Machine.
No. 6 Whitney Hand Mill.
★ **28 x 60 Cincinnati Vertical Hydro-Tel Milling Machine, single spindle with profile tracing attachment, m.d. New in 1942.**

PLANERS AND SHAPERS
16" Gould & Eberhardt Crank Shaper.
20" American Crank Shaper, m.d.
★ **6" Pratt & Whitney Vertical Shaper.**
No. 14 Cochrane & Bl. Vertical Shaper.
36" x 36" x 12' Liberty Planer, 2 heads, box table.
42".x 42" x 20' Cincinnati Planer, D.C. Rev. M.D.

TAPPERS
No. 2X Garvin Tapper, m.d.
No. 2BG Garvin.
Leland-Gifford Radial.

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No. 3 W & S Turret Lathe
No. 2-B Foster Turret Lathe

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Millers, Vertical No. 3 B & S & No. 4 Cin.
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2½", 4" Binsee
66" Niles
54" Colburn, M.D. 2 hds.

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Foster Nos. 4, 5, 6, 1B, 3B M.D. Univ.
J. & L. 2¼"x24", 3¼"x36".
Acme #2 M.D.
No. 1L, 2L Gisholt Univ. M.D.
No. 3 W & S Grd. Hd., Univ., M.D.

GRINDERS

P. & W. 14", B.B., Vert. M.D.
Blanchard 30", M.D.; Modern 12x48" M.D.
Norton Hydraulic 12x18", M.D.
Heald Nos. 72A3 Gagematic
Norton 50"x28', M.D.
Landis Type A 6x20" Hydraulic, M.D.
Bryant No. 12, M.D.
No. 55, 60, 65 Heald int. Hydraulic, M.D.
12" Heald Rotary Arter 12" M.D.
B. & S. No. 2, 2B Surface, M.D.
B. & S. No. 10 1 Cyl.
No. 2 Cincinnati Centerless M.D.
B. & S. No. 1, 3 Universal
#25 G. & L. M.D.
#25A Heald, M.D.

LATHES

10"x3' South Bend, M.D.
Monarch, Hendey 12x30 geared head
26x12' Boye & Emmes 3 step cone B.D.G.
14"x6' Hendey
9" LeBlond Automatic
36x30' Putnam M.D.
36x22" Putnam, D.C. M.D.
32"x35' Wickes
Putnam 42x16', M.D. S.C.G.
P. & W. 1x18, Automatic Lathes

AUTOMATICS

Cleveland Model A ½", ⅞", 1¼", 2"
Cleveland Model B 1", 2"
P & J 6A, M.D.
⅞" Cone 4 spindle, Gridley
B & S #0

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Spot & Arc Welders
5, 10, 18 & 30 ton OBI Power Presses
7" Ammco Shapers
H.S. Vertical Milling Heads, Drill Presses, Foot Presses
Kalamazoo Metal Band Saws
8" Shap-Rite Shapers
No. 1½ Abrasive Surface Grinder
6x6" Racine Hacksaw
20 & 30 ton Northern Hydraulic Presses

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4', 5', 6' American Triple Purpose
4', 5' Cincinati-Bickford
4' Muller, M.D.; 4' 5' Western, S.P.D.
4' Fosdick arranged for motor drive

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#2HL Milwaukee, M.D.
No. 3S Cincinnati, S.P.D. rapid trav. M.D.
Nos. 0Y, 3, 4, 5 B & S Plain & Univ.
B. & S. Nos. 12, 13, 13B
Hall Planetary Model D Thread Miller
Becker Nos. 3, AB, 5, 6, Vert.
Nos. 2, 3, 4, Cincinnati Vert.
P. & W. No. 2, 30 Profiler M.D.
K. & T. B. & S., No 2, 3 like new
B. & S. No. 1, 3, Vert.
#22L Van Norman Univ.
#2B K & T Univ.

MISCELLANEOUS

Buffalo #0 Bending Roll, M.D.
#20, 21 Bliss OBI Power Presses
Gorton No. 1S Engraving Machine 3Z
6 spindle Avey Drill 15" overhang
Rochester No. 5½" B Hammer
6" Vertical Shaper P & W
Oster Pipe Machines, 4", 6"
N.B.P. 15" Slotter M.D.
10x10 Peerless Universal Shaping Saw
#7, 72 Fellows Gear Shapers
Lennox Throatless shear ¼" cap., M.D.
Decker Engraving Mchs., G1, G2

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#4 Cincinnati Vertical Miller, rotary table, power fed.
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Warner & Swasey 4, 3A, 4A, Turret Lathes

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Drills, sensitive, 2 and 4 Spindles
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Drills—New—18" Royal Motor driven (10)
Gear Cutter, Brown & Sharpe #3—26
Gear Cutter, Gould & Eberhardt 42"
Grinder, Webster and Perks #1-¾ motor drive
22" Buffalo Pr. Fd. Motor Drive, New
16"x6' Hendey Lathe, Quick Change Gear
Magic Chucks #1-2 & 3 and Collets
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Planer, 24"x24"x6' Pease motor drive
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#560-F GIDDINGS & LEWIS, Floor Type, M.D.

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#72A3 HEALD Plain & Sizematic, M.D.
#5 B & S Plain Grdr., M.D.
4"x12" LANDIS Type H Plain, M.D.
14"x168" NORTON Type "C" Plain, M.D.
#4T SELLERS Tool Grdr., M.D.
9" P & W Hvd. Gear Grdr., M.D.
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50"x17' centers LEBLOND "BIG SWING", M.D.

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#2HL K & T Plain, M.D.
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#M-50A TAYLOR & FENN Vert., M.D.
#2MS CINCINNATI Vert., M.D.
#3MS CINCINNATI Vert., M.D.
#3HS CINCINNATI Vert., M.D.
#3K K & T Vert., M.D.
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#1A W & S Saddle Type Univ., M.D.

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1⅛" Cleveland 4 spindle
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12"x63" & 14"x19" Fay
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Gisholt simplimatic

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HP50 Lapointe
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Nos. 3-B & 5 Foster universal
Nos. 3 & 5 J. & L. universal
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24" & 42" Bullard vertical
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No. H-1 Micromatic Hydrohoner
#211 Barnes honer
No. 9 LeBlond Multicut lathe
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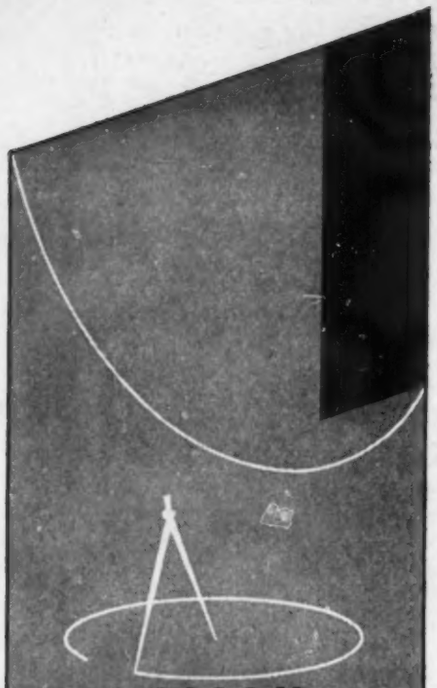

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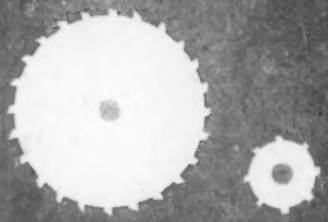

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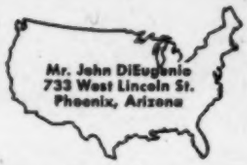

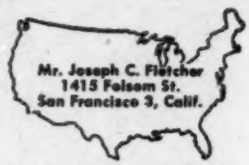

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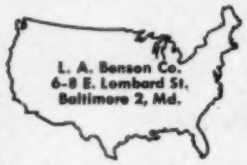

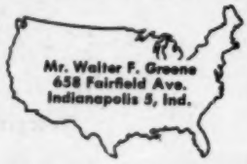

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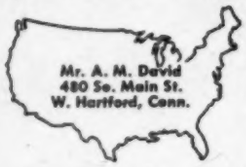

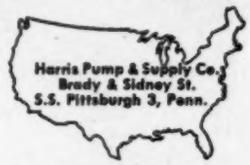

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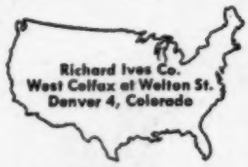

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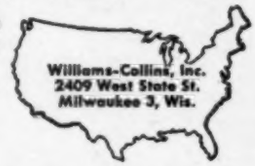

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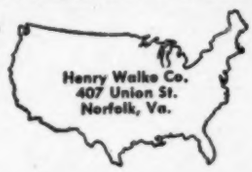

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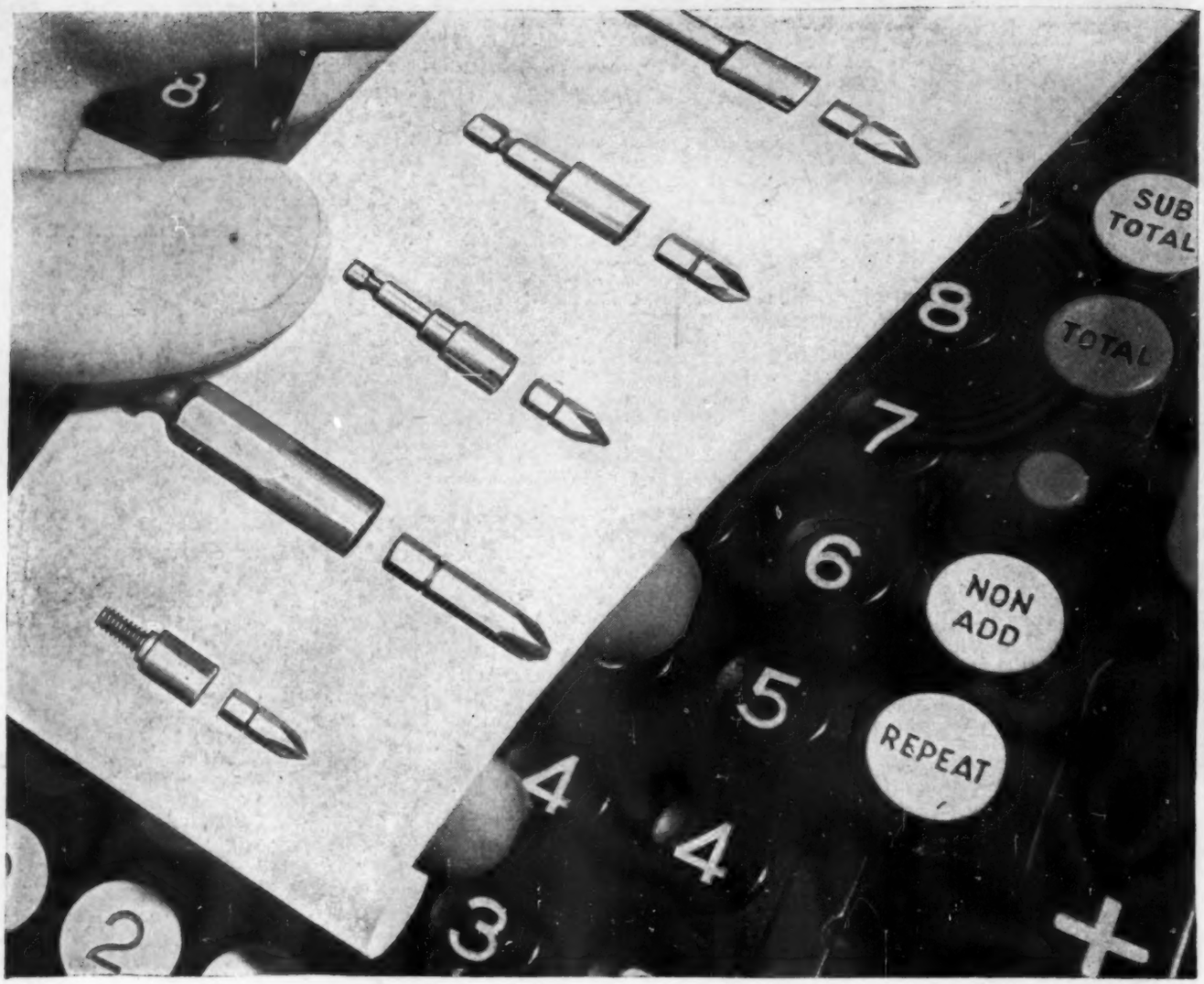

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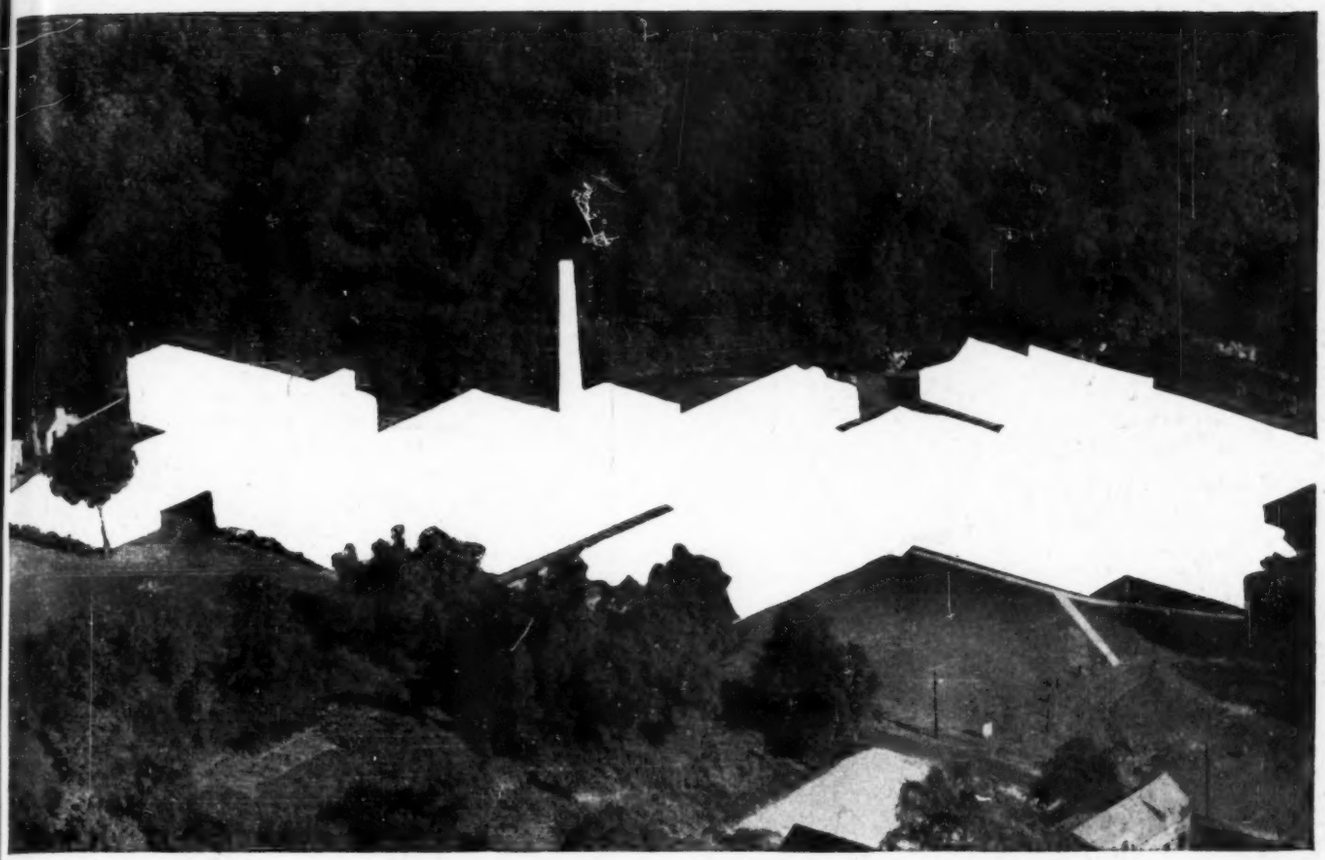

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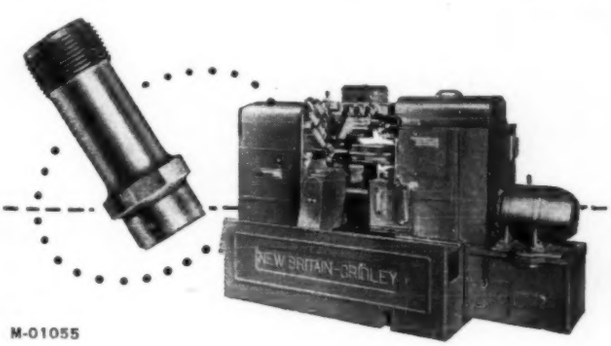

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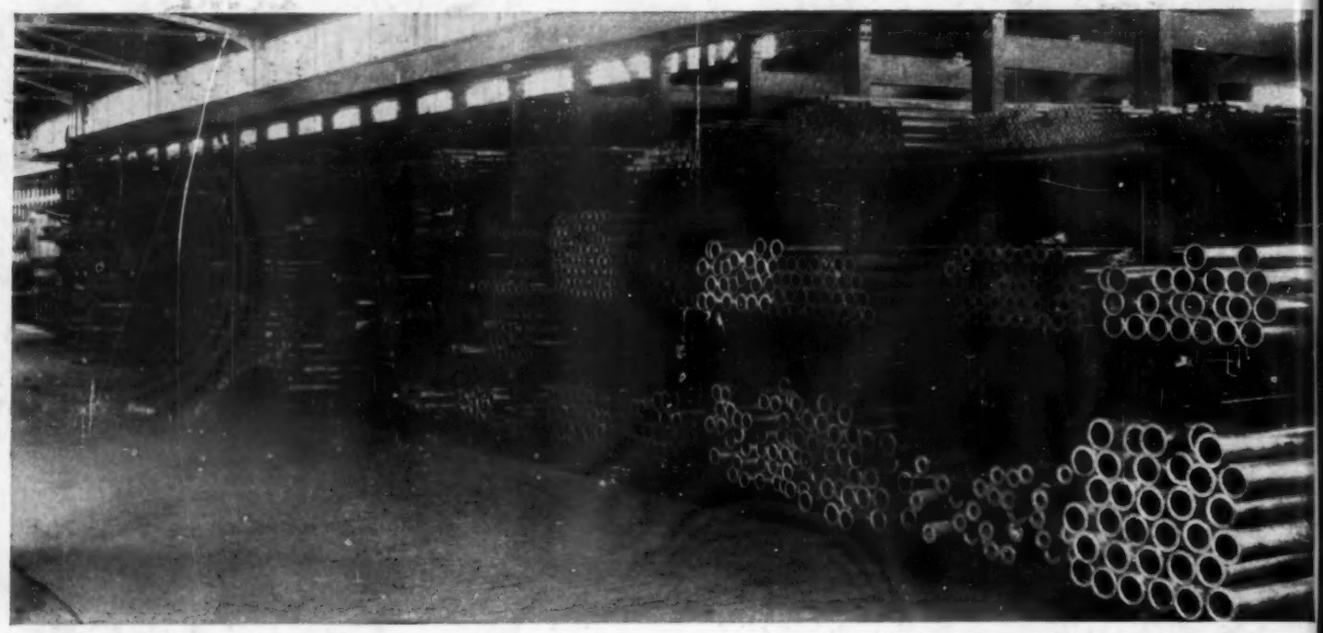

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